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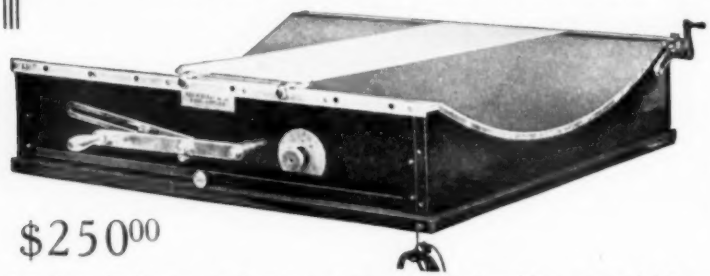

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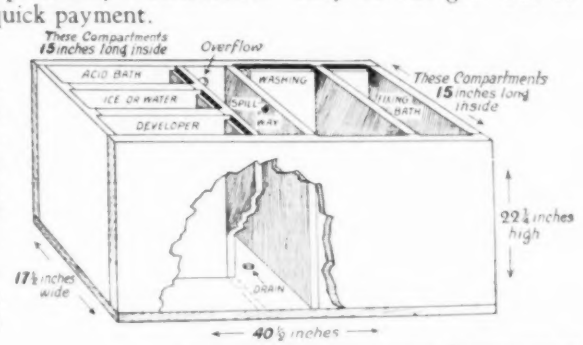

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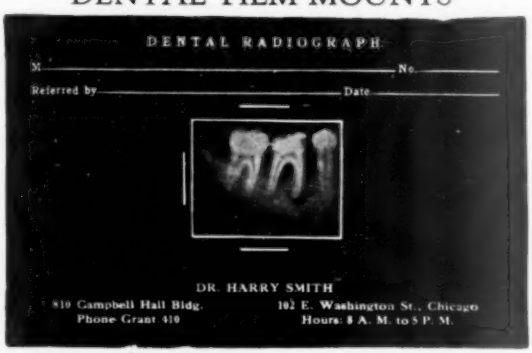

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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XVI NOVEMBER, 1926 No. 5

OSTEOPETROSIS*

BY ROLLA G. KARSHNER, M.D.

LOS ANGELES, CALIFORNIA

INTRODUCTION

Definition. Osteopetrosis is an hereditary disease, essentially a disturbance of the mesenchyme, manifesting itself primarily by extraordinary thickness and density of the cortical portion of the osseous system at the expense of the medullary portion, and giving rise to a diversity of secondary characteristics such as multiple fractures, epiphyseal deformities, physical underdevelopment, hydrocephalus, optic atrophy, imperfect dentition, anemia, various leucemic states, and metaplasia of bone marrow elements leading to enlargement of the liver, spleen and lymph nodes. None of the secondary manifestations are essential. They may be so severe as to cause death soon after birth. On the other hand, there may be none as late as middle life, the subject remaining in ordinary good health.

Synonyms. The disease has heretofore been described under various names: Marmorknochen; marble bones; Marmorskelett; Albers-Schönberg's disease; diffuse Osteosklerose; angeborene Osteosklerose; congenital osteosclerosis; Osteosklerose und Anaemie; osteosclerosis fragilis generalisata; osteosclerosis; and as osteosclerosis associated with various forms of the leucemias.

Osteosclerosis is a generic term used by pathologists to denote hardening or abnormal density of bone due to chronic inflammations, osteomyelitis, phosphorus poisoning, osteoplastic carcinoma and the like. Osteosclerosis congenita is one of the many names attached to achondroplasia. Textbooks of pathology state that osteosclerosis may be diffuse and involve all the bones from causes unknown. It is this group that should be taken from the general classification and designated as a specific disease. The name "marble bones" was suggested by the uniform white appearance of the bones in the roentgenograms of the first instance of osteopetrosis of which there is such record. It is obviously inappropriate in the light of present knowledge of the disease. The term osteopetrosis (stony bones) is chosen because in one word it describes the primary pathological condition, bone petrifaction It suggests fragility as well as hardness, limestone rather than marble.

Historical. In 1904 Albers-Schönberg first called attention to a disease of the skeleton which he described from roentgenograms as showing: (1) preservation of the structural contours of the bones; (2) transformation of the medullary canal and spongy portions into compact bone substance, and (3) probably increased lime content. A search of twenty years' literature has revealed so few cases that the essentials of each may be briefly reviewed.

* From the Childrens Hospital, Los Angeles, California.

COLLECTED CASES FROM THE LITERATURE

I. M., 26, multiple fractures, the disease dating from earliest childhood. Roentgen ray: medullary and spongy portions changed to compact bone, parallel bands of density (striations) in metaphyses, clubshaped thickening of posterior clinoid process. Liver, spleen and lymph glands enlarged. Hgbl. 30; R.B.C. 3,280,000; W.B.C. 6,200; 49 per cent lymphocytes, anisocytosis, polychromasia. At 44 years of age condition the same.

Author, Albers-Schönberg, 1904, 1907, Reiche, 1915, Lorey and Reye, 1923.

No pathological examination.

II. M., one day, hydramnios, generalized osteosclerosis, liver reached to navel. Thymus, heart, thyroid, spleen enlarged. Normal blood picture. Death.

Author, Assmann, 1907.

Pathological examination, diffuse osteosclerosis.

Histological examination, bones sclerosed, cortex poorly distinguished from thickened spongiosa, scarcely any marrow space, just lacunae filled with fibrous tissue and capillaries. Osteoblasts—a bone building process. Much blood building in the liver.

III. Child, 30 hours, good size, well nourished. Death.

Pathological examination: sclerosis of bones, cortex thickened, spongiosa condensed. Marrow space markedly narrowed, marrow free from fiborus change. Unusual development of artery branches in middle of bones. Marked growth of hypophysis. Thyroid and thymus moderately enlarged. Normal blood picture.

Author, Schmidt, 1907.

IV. F., 10 weeks, hemorrhages, jaundice and pallor. Underdeveloped, liver and spleen enlarged. Hgbl. 22; R.B.C. 1,100,000; W.B.C. 75,000. Diversity of size of red blood cells, average increased, marked poikilocytosis, polychromasia, basophilic stippling, megaloblasts 54,000; normoblasts 48,000. Poly. neut. 26 per cent; L.L. 14.5 per cent; S.L. 9.75 per cent; Eos. 1.5 per cent; Neut. myelocytes 46 per cent, which stained with difficulty; Eos. myelocytes 2 per cent; basophils 0.25 per cent. Death.

Author, Goodall, 1912.

Pathological examination: marked increased density of all the bones with obliteration of marrow spaces.

Histological examination: myelogenous leucemia. Humerus showed no medullary cavity. Spaces surrounded by thick bony trabeculae. All available spaces occupied by hemopoetic cells.

V. M., $3\frac{1}{2}$, fracture rt. leg. Roentgen ray typical with globular thickening lower thirds of femora. Failing vision for two years. Hydrocephalus, undergrowth. Only two calcified epiphyses at wrist. Severe anemia with megalocytes and megaloblasts. At seven years of age died of anemia and necrosis of the jaw.

Author, Sick, 1914, Lorey, 1920, Lorey and Reye, 1923.

Pathological examination limited to opening of cranial cavity, showed all bony orifices narrowed, pachymeningitis hemorrhagica.

VI. F., $2\frac{1}{2}$, sister of V. Fractures of femora. Roentgen picture typical with club-shaped thickening of posterior clinoid process, metaphyses markedly sclerosed. Undergrowth. Failing vision for $1\frac{1}{2}$ years, nystagmus, optic atrophy, paralysis of occular muscles, which improved after lumbar puncture. Severe anemia. Died at seven years of age of necrosis of the jaw.

Author, Sick, 1914, Lorey, 1920, Lorey and Reye, 1923.

Autopsy denied.

VII. M., 3 weeks, brother of V and VI. No fractures, roentgen picture typical, bones of extremities uniformly dense. Optic atrophy. Centers ossified for first and second metacarpals and for the first four metatarsals. Gravest lethal anemia. Died at $3\frac{1}{2}$ months of age of necrosis of the jaw.

Author, Lorey, 1920, Lorey and Reye, 1923.

Autopsy denied.

VIII. F., 15, cousin of mother of V, VI, and VII. Sustained fourteen fractures. Roentgen examination: skull structureless, sella narrow, clinoid process prominent. Vertebrae, ribs, pelvis and all bones dense, femora bowed at necks with club-shaped thickening especially at knees, knobby thickening upper ends of leg bones and humeri, striations in lower ends. Epiphyses and diaphyses completely structureless except in the lower portions of legs where cortex can be distinguished from medulla. Orbit thickened and narrowed, facial portion of skull masklike. Underdevelopment. Optic atrophy. Grave anemia. Died at 15 years of age preceded by suppuration of lower jaw with loss of all teeth.

Author, Sick, 1914, Lorey, 1920, Lorey and Reye, 1923.

No pathological examination.

IX. M., 12, history of four fractures. Roentgen evidence of many more healed fractures. Increased density all bones with striations lower ends of long bones, also in flat bones. Upper ends of humeri, distal ends of femora, proximal ends leg bones clubbed. Coxa vara. Tarsal bones showed transparent centers, striations in metatarsals, metacarpals and carpal phalanges; sella small. Diagnosed

rickets at three years of age. Sat alone at one year, walked at $2\frac{1}{2}$ years. Hydrocephalus, nystagmus, failing vision. Lymph glands and spleen definitely palpable. Secondary anemia. Hglbn. 80; R.B.C. 3,900,000; W.B.C. 8,300. Undergrowth, chest deformed, teeth carious, optic atrophy. No increase in blood calcium.

Author, Laurell and Wallgren, 1921.

No pathological examination.

x. M., 11. No fractures. Roentgen ray: calcification of ligaments, periarticular tissues and vessels. All bones compact structureless mass except lower ends diaphyses of forearms, midportions of leg bones, and center of pelvis. Femora and bones of forearms and legs showed bending of axes, left coxa valga. Humeri clubbed. Extreme emaciation, poor teeth, right scoliosis. Features senile, delicate. Marked arteriosclerosis. Massive calcifications in the soft tissues. Grave anemia. Liver palpable. Blood calcium double normal amount. Reflexes exaggerated. Died at eleven years of heart failure.

Author, Schulze, 1921, 1923.

Pathological examination, complete obliteration of medullary canals and spongiosa, thickening posterior clinoid process, all skull orifices narrowed, dura adherent to bone, lime deposits in joint capsules, ligaments, myocardium, lungs, stomach mucosa, and all arteries of viscera including parathyroids. Lime infarcts in kidneys.

Histologically no osteoclasts. Osteoblasts diminished. Calcification of osteoids. (This case was complicated by so-called Kalkmetastasis.)

xi. M., 11, multiple fractures. Roentgen ray: compact structureless bones showing striations in long bones, and bones of hands and feet, clubbing of ends of long bones. Shafts of leg bones bowed. Dorsal scoliosis. Club-like thickening of posterior clinoid process. Well nourished. Teeth carious, lymph glands palpable. Slight Harrison's groove. Hglbn. 86; R.B.C. 4,992,000; W.B.C. 11,000

Author, Davis, 1922.

No pathological examination.

xii. M., 8, no fractures. Roentgen ray: typical increased density of cortex obliterating the medulla. Coxa vara. Patient the seventh, and only living child of his father. Premature birth. Fairly well developed and nourished, bright and active. Enlarged lymph glands. Hglbn. 70; R.B.C. 4,600,000; W.B.C. 7050. Slight anisocytosis and poikilocytosis. Blood calcium normal, blood phosphorus probably increased.

Author, Ghormley, 1922.

No pathological examination.

xiii. M., father of xii. Perfectly well adult with normal blood picture who showed roentgen findings typical of those under discussion.

Author, Ghormley, 1922.

No pathological examination.

xiv. F., 43, multiple fractures. Roentgen ray: dense structureless bones throughout. Club-like thickening of posterior clinoid process. Consanguinity on mother's side. Hglbn. 45; R.B.C. 2,940,000; W.B.C.; 4500; poikilocytosis, with many oversized red cells. Four years later no change. Fracture of femur did not heal.

Author, Alexander, 1923.

No pathological examination.

xv. F., 35, multiple fractures. Roentgen ray: compact bone structure with obliteration of marrow spaces. Sella small, club-like thickening posterior clinoid process. Left scoliosis. Diagnosed rickets as a child, walked at 4 years of age. Before roentgen examination, considered late rickets. Small, graceful, pale, turricephalus, forehead prominent, teeth very bad. Pigeonbreast, slight labyrinthine deafness. Blood normal. Calcium content of blood and urine normal. After a month, open operation on fracture of femur permitted removal of piece of bone for study.

Author, Clairmont and Schinz, 1924.

Pathological examination, bone very hard, apparently no medulla.

Histological examination, qualitatively absolutely normal structure and texture of bone substance. Quantitative increase in cortex wrought by endosteal new bone growth at expense of medulla.

xvi. M., 4 months, fracture. Roentgen ray: all bones structureless, condensed, medulla recognizable only in metaphysis of femur. Centers of pelvic bones less dense. No epiphyses at wrists. Epiphyseal lines jagged, many places resembling "Trümmerzone." Pipe-bowl-like thickening of costochondral junctions. Fresh fracture 11th rib. Pallor, underdeveloped. Hglbn. 48; R.B.C. 3,3000,000; W.B.C. 62,000; all types nucleated red blood cells, polychromasia. Large, hard spleen. Large liver and lymph glands, rosary. Fontanelle, large, stretched, epiphyses large, legs bowed, ptosis left eyelid. Death.

Author, Nadolny, 1924.

Pathological examination, bones sclerotic, compact, no marrow space. Histological, myelocytes in liver, spleen and lymph glands. Density of bones with obliteration of marrow channels by fairly normal appearing cortical bone, osteoblasts, practically no osteoid tissue. Few osteoclasts. Fibrous marrow showed few osteoblasts. Epiphyseal lines here and there irregular and ragged—a disturbed calcification of the cartilage.

XVIII. F., 3, fracture three days after birth. Enlarging tumor of the abdomen. Gradual onset of blindness. Pallor, total blindness, large hard splenic tumor. Hglbn. 33; R.B.C. 2,700,000; W.B.C. 12,800. Lymphocytes 46 per cent. Anisocytosis, poikilocytosis, polychromasia, normoblasts. Last week of life 13 per cent myelocytes. Died.

Author, Kraus and Walter, 1925.

Pathological examination, grave general anemia, general atrophy, splenic hypertrophy, hyperplasia and hyperemia of lymph nodes, thickening and condensation of bony cortex at expense of medulla, subperiosteal hemorrhages, hemorrhages in dura, which was thickened and adherent to skull, thickening of leptomeninges, chronic internal and external hydrocephalus, optic atrophy, narrowing of optic canal, edema of brain. Healed fracture right femur.

Histological examination, osteoblasts diminished. Many osteoclasts. Fibrous marrow becoming osteoid tissue and replacing normal marrow.

XVIII. M., 26, fracture neck left femur following trivial injury five years previously which healed in two years. Roentgen ray: homogeneous increased density of bones without differentiation of cortex and spongiosa. Epiphyseal lines still open. Posterior clinoid process thickened. Cut teeth late, walked at fourteen months. Good student but always excused from gymnasium. From beginning of school period arms and forearms became bent with thickening of bones. Later legs similarly affected. Extension at elbows limited. At fourteen years suppurative wounds of toes which healed in a year after discharging bone sequestra. In the last year similar lesions on fingers which failed to heal. Teeth bad. Eight years previously suppuration of jaw. For five years gradually increasing feeling of pressure in left abdomen. Pallor and weakness progressive. At examination patient appeared eighteen years of age. Pale, poorly nourished, slight musculature. Dolicocephalus with prominent parietal bosses. Most of teeth missing. Thickening of mandible at site of previous suppuration. Thorax deformed. Lower ends of humeri thickened. Arm bones deformed, thickened at proximal ends, bent at distal ends. Fingers bent. Extension of elbows limited. Pelvis slightly deformed due to old fracture of femur. Left hip joint movable only in sagittal direction, trochanter thickened, high. Head of femur downward and backward without acetabulum. Tibiae twisted and thickened. Fibulae thickened. Metatarsals thickened. Left toes stiff. Suppuration right toes. Nasal breathing difficult. Cervical and inguinal glands palpable. Large, hard, smooth spleen. Large soft liver. Hgbln. 36; R.B.C. 2,000,000; W.B.C. 5300; eosinophils 1 per cent; myelocytes 1–2 per cent; immature cells 4–5 per cent; transitionals 8 per cent; polymorphonuclears 52 per cent; lymphocytes 31 per cent; mononuclears 2 per cent. Anisocytosis, poikilocytosis, few normoblasts, polychromasia. Blood calcium normal. Examination of lymph gland from neck showed myeloid metaplasia.

Puncture of sternum revealed no bone marrow, but rather, ivory-like bone lamellae.

Author, Bernhardt, 1926.

DISCUSSION

There can be little doubt that the foregoing are instances of the same malady. In 1879 Heuck wrote of the pathological findings in diffuse osteosclerosis and splenic leucemia. There has followed a small series of autopsy reports of generalized osteosclerosis associated with disease of the blood-forming organs,—Baumgarten (1899) myelogenous pseudoleucemia; Schwarz (1901) leucemia; Schmorl (1904) leucemia; Askanazy (1904) leucemia; Nauwerck and Moritz (1905) atypical leucemia; Lehndorff and Zak (1907) myelogenous leucemia; Assmann (1907) Case I splenic anemia, Case II anemia gravis, Case III pseudoleucemia lienalis; Pastore (1922) pseudoleucemia. Only the pathological reports exist. Roentgenograms are not available. I have not classified these as osteopetrosis, though they are very similar and perhaps some of them are actually cases of the disease. It is not clear, however, in any case that the osteosclerosis existed as a congenital primary affection and induced the blood changes, or whether it was the result of the latter in the nature of a scarring process in the bone marrow. Either sequence is reasonable, and probably both occur.

The case of Oesterlin (1923), a two year old child with bone pains, severe anemia, myelocytes, splenomegaly, myeloid metaplasia and osteosclerosis, is excluded because the description indicates that periosteal changes were a large factor in producing the increased density of the cortical bone. The case is not unlike that of v. Jaksch (1901), a female of twenty-four years with bone pains, osteosclerosis of periosteal origin, splenic tumor

and grave myelogenous leucemia. Taylor's case (1926) with periosteal changes in a two-year-and-ten-month-old child with lymphatic leucemia may not be greatly dissimilar, though appreciable bony sclerosis had not occurred.

It is my privilege to add 4 cases of osteopetrosis observed at the Childrens Hospital.

CASE REPORTS

Case I. (24-209-) Female, aged eleven and one-half months, admitted Nov. 1, 1924 on account of undernourishment. The working diagnosis until the roentgen-ray examination revealed the nature of the illness was rickets and tetany.

The baby was the fifth living child of healthy parents. Full term, normal delivery. Birth weight 6 pounds. Breast fed until she became fretful four weeks ago when a diagnosis of rickets was made and treatment as such instituted. She continued to fail, however, with listlessness, loss of appetite and convulsions the day of admission.

Physical Examination. Apparently blind, poorly nourished, pale, "rachitic" baby. Skin dry, wrinkled, much hair. Muscles wasted, spastic. All epiphyses enlarged. Weight $10^{15}/_{16}$ lbs. Temperature 103.2°F. Fontanelle open, bulging and tense; sutures open—moderate hydrocephalus. Eyes, optic atrophy, outward strabismus, lateral nystagmus, pupils equal, react sluggishly to light. Facies; the eyes are wide apart, not slanting, mouth not open, tongue not protruding, epicanthic fold not thickened, root of nose sunken, tip turned up, lips thick,—with this a wrinkling of the skin and appearance of senility.

There were a few palpable lymph glands. The chest was asymmetrical, the right side larger than the left, barrel shaped, with very prominent rosary.

Abdomen distended, liver 2 fingers breadth below costal margin. Spleen felt. Knee jerks increased. Hgbln. 70; R.B.C. 3,560,000; W.B.C. 17,825; S.L. 56 per cent; P.N. 40 per cent; P.E. 4 per cent. Lumbar puncture, clear fluid under increased pressure. Blood Wassermann negative on patient and parents.

Roentgen examination of the entire body showed a uniformly generalized increased bone density. Medulla could be made out only faintly in the lower portions of the shafts of the humeri. The anterior fontanelle was open. There was the characteristic thickening of the posterior clinoid process. Knobby thickening involved the anterior ends of the ribs and the ends of the diaphyses of all the long bones and the metacarpals, metatarsals and phalanges. The outlines of the tarsal bones were of dense compact bone which contrasted with the less increased density of their centers.

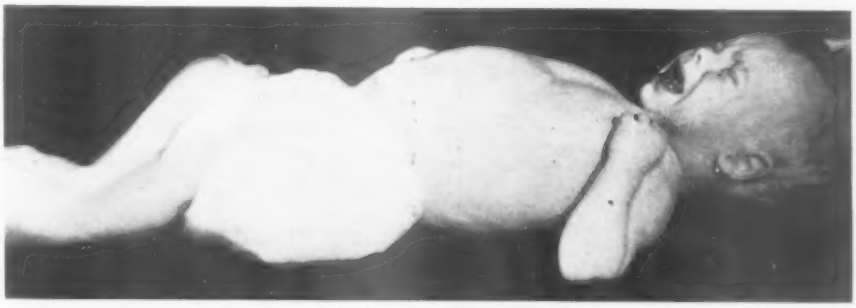

Fig. 1. Photograph of Case III, showing typical facies.

The patient became jaundiced, vomited, developed diarrhea, dying on the third day with a final diagnosis of osteopetrosis, bronchopneumonia. Autopsy denied.

Case II. (OPD25-2564) Female, aged nineteen months, was brought to the Outpatient Department June 16, 1925, because she had failed to develop properly, having cut no teeth, could not stand, and had made no attempt to talk. She is the third living child of healthy parents, her birth preceded by two abortions, and followed by another. Full term, normal delivery. Birth weight 6 pounds. Breast fed for five months, then weaned to goat's milk.

Physical Examination. Weight $10^{3}/_{16}$ pounds, with the appearance of an infant of six months. Pale, undernourished, muscles soft, poor tone. Epiphyses enlarged, head

square, fontanelle open, the face is wide, root of nose sunken, tip thick and turned up, nares round, far apart, eyes apart, but not Mongolian, lips thick. No teeth. Blood Wassermann negative.

Roentgen examination of the entire body revealed uniformly generalized increased density of all the bones. Medulla could be made out in the metaphyses of the femora and leg bones.

Fig. 2. Photograph of Case iv, girl aged eleven.

The anterior fontanelle was open. The posterior clinoid process was thickened. A moderate degree of knobby thickening of the metaphyses of the long bones was noted. Beginning transverse striations were manifest for 1 cm. along the lower ends of the diaphyses of the femora. No epiphyses were ossified for the upper ends of the femora. There were no visible epiphyses whatever at the wrists. Those for the lower ends of the femora and the upper ends of the tibiae were small, irregular in outline and not as yet densely calcified.

The parents refused to allow the baby to be admitted to the hospital and further examination was not permitted. She was placed upon an antirachitic regime to be carried on at home.

September 1, 1925, about ten weeks later, she was presented for examination. It was learned that in the interval a physician had been treating her with thyroid extract without improvement. Her diet had been good. In addition to pallor, she was somewhat jaundiced in appearance. Her appetite was good. She had cut two teeth, could sit up, was well nourished, of good disposition, smiled and recognized people and objects. She could say mama, papa, dada; had gained 7 pounds in two and a half months, although there was no change in her measurements. The fontanelle was still open. Development at this time was estimated at not beyond ten or eleven months. The parents refused hospitalization.

Repeated attempts have failed to bring this infant back for observation. The visiting nurse reports her condition not materially changed. Note dated May 25, 1926, states that she has 8 teeth, stands alone and takes two or three steps alone.

Case iii. (26–405) Male, aged three and a half years, the second child of normal parents, was admitted March 5, 1926 because he had never done well. Full term, normal delivery. Birth weight 8¼ pounds. Breast fed four months, then cow's milk.

The child cannot sit up. He holds the head up at times. Has never attempted to talk. The diagnosis prior to the disclosures of the roentgen examination was rickets.

Physical Examination. Blind, pale, undernourished, poorly developed albino child of the appearance of fifteen months of age. Weight 21 pounds. Skin, no pigment, wrinkled with much hair. Fontanelle still open, eyes wide apart, root of nose sunken, tip broad and turned up, lips thick, pupils react to light and in accommodation, blindness, optic atrophy, lateral nystagmus, lack of pigment. There are thirteen teeth, all carious. Lymph glands palpable. Epiphyses enlarged, rosary. Spleen and liver much enlarged. Umbilical hernia. All reflexes exaggerated. Hgbln. 30; R.B.C. 3,000,000; W.B.C. 6,700; S.L. 70; P.N. 30; achromatophilia, anisocytosis, poikilocytosis, polychromatophilia. Blood calcium normal. Blood Wassermann negative on patient and parents.

Roentgen examination of the entire body showed uniform compact bones throughout. Medullary canals were discernible only in the lower portions of the femora. The anterior fontanelle was open. There was club-like thickening of the posterior clinoid process. Knobby thickening involved the metaphyses of all the long bones, metacarpals, metatarsals and phalanges. Transverse striations were noted

in the lower ends of the shafts of the femora and leg bones. There were no ossified epiphyses at the wrists, none for the upper ends of the humeri or femora, none whatever for the leg bones.

The course in the hospital was uneventful. He was discharged to the Outpatient Department March 28, 1926. Subsequent examinations have shown virtually no change in the child's condition.

fractured the left femur for which she wore a cast for three months.

She has one brother, aged seven, in good health. Full term, normal delivery, birth weight 4½ pounds. She was born in Germany of German parentage; breast fed two months.

Physical Examination. Slight, undernourished, physically underdeveloped child, fairly

FIG. 3. Roentgenograms of Case I, aged eleven and a half months, showing generalized increased density of bones. Film of the head was slightly abraded and is not reproduced here.

CASE IV. (26–413) Female, aged eleven, was admitted March 6, 1926, on account of fracture of the upper end of the right femur following a very slight fall a few hours previously. The diagnosis made prior to the roentgen examination was osteopetrosis.

At four years of age she had sustained a fracture of the right leg. At six years the left hip was in a cast for nine months for supposed tuberculosis. After removal of the cast she

bright, and of good disposition. The facial appearance is that of an old lady. Eyes, optic atrophy, completely blind in right eye, partially blind in the left. Teeth carious, alveolar development arrested. Liver and spleen palpable. A few palpable lymph glands. Hglbn. 70; R.B.C. 4,500,000; W.B.C. 10,200, S.L. 33 per cent; Trans. 1 per cent, P.N. 66 per cent; blood calcium normal; blood Wassermann negative.

Roentgen examination of the entire body revealed a uniformly compact bone structure throughout. Medullary canals were recognized only in the lower ends of the diaphyses of the humeri. There were no pneumatic structures in the head. The posterior clinoid process was thickened. Clubbing involved the upper ends of the humeri and leg bones, and was most marked at the lower halves of the femora which were more than double the width of the upper portions of the bones. Each os calcis presented a somewhat transparent center.

She remained in overhead traction until May 27, 1926, when she was placed in a cast, and was discharged from the hospital June 8, 1926. At this time there was no evidence of callus or healing. August 19, 1926, the fragment ends showed healing with a moderate amount of bony callus.

ETIOLOGY

Incidence. The disease has been rarely recognized in the past and was unknown

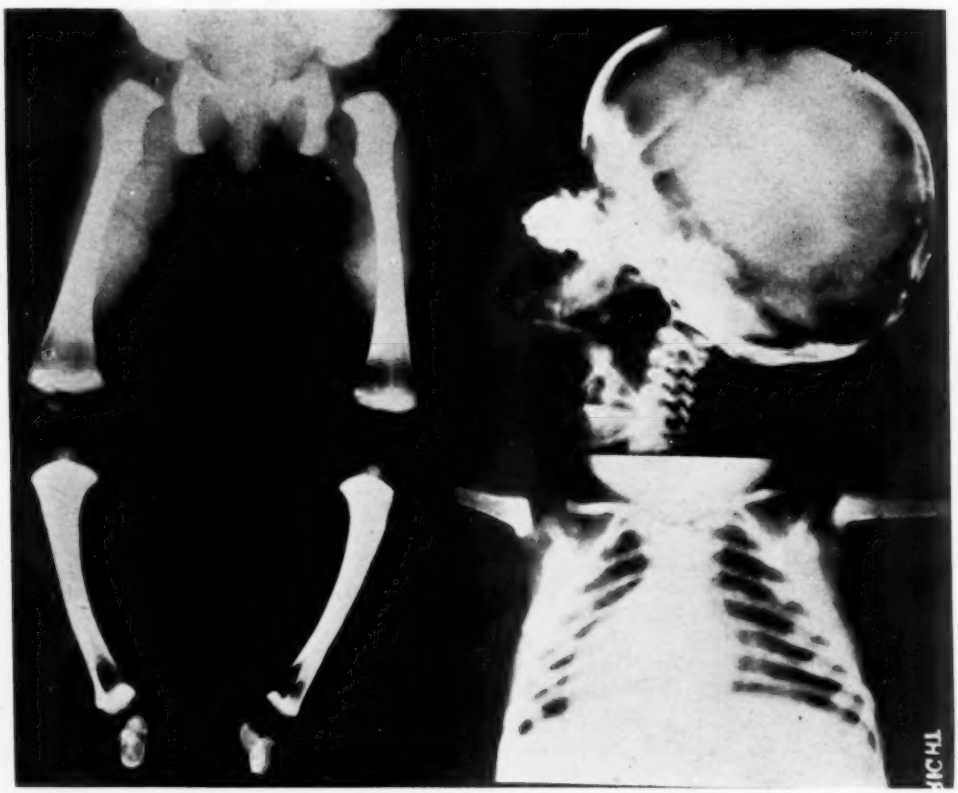

Fig. 4. Representative films of Case II, aged nineteen months, showing characteristic increased bone density. The transverse striations in the lower ends of the femora are lost in reproduction.

This child, being older, presented much more extensive transverse striations of the long bones extending a considerable distance along the shafts. They were present throughout the widened lower ends of the femora, in the lower portions of the leg bones and in both the upper and lower portions of the shafts of the bones of the forearms. A recent transverse fracture involved the upper third of the shaft of the right femur. Evidence remained of old healed fractures involving the upper portion of the left femur, the middle of the shaft of the right humerus and the upper third of the same. Deformities existed at the neck of each femur.

before the advent of the roentgen ray. Doubtless many instances are still overlooked. Four cases were discovered at the Childrens Hospital in the two-year period July 1, 1924 to July 1, 1926, out of 2,752 new patients under twelve years of age admitted for all causes to the Roentgen-Ray Department. During the same period other of the rarer generalized bone dystrophies occurred as follows: 3 achondroplasia; 2 hereditary deforming chondrodysplasia; 3 osteitis fibrosa cystica; 2 osteopsathyrosis. Barring rickets, scurvy,

and hereditary lues of the bones, this then has been the commonest bone dystrophy during the last two years. Case IV only of this series was correctly diagnosed clinically previous to the revelations of the roentgenograms.

Age. The disease has its onset as early as the beginning of ossification. The primary changes are known to exist into adult life without symptoms. The earlier the symptoms appear, the more serious the failed to throw any light on the etiology of the disorder. There is obviously a disturbed calcium metabolism with an augmented ability to bind calcium, the nature of which is not yet clear. In several instances the blood calcium was normal. Ghormley's case showed a possibly increased blood phosphorus content. However, complete and exhaustive metabolic studies in osteopetrosis have never been carried out.

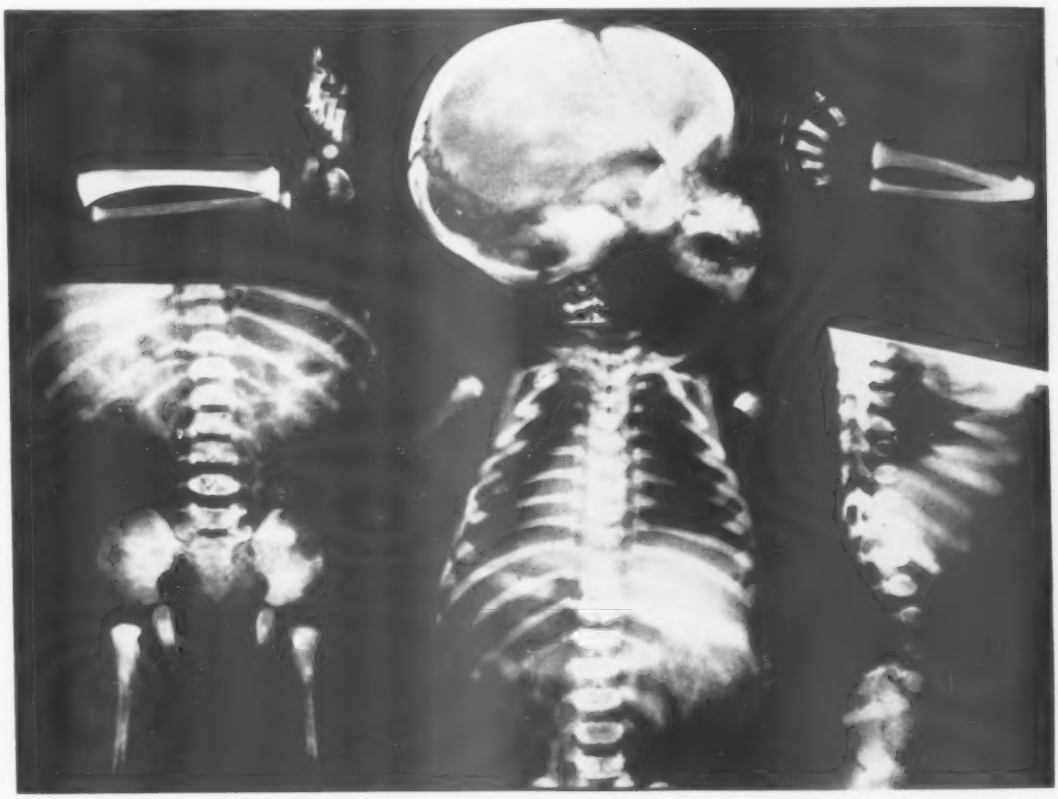

FIG. 5. Roentgenograms of the greater portion of the body of Case III, aged three and a half years. Much detail is lost in reproduction.

disease. Doubtless the most severe instances die *in utero*, as abortions, miscarriages, and stillbirths are common in the parental histories. Out of the 22 collected cases, only 5 occurred in adults. In 3 of the latter the symptoms dated from early life. In a fourth, the first fracture occurred at the age of thirty-one. The fifth case was without symptoms.

Sex. In the reported cases the sexes have been equally divided.

Internal Secretions. Studies to date of the endocrine glands and metabolism have

Vitamines. Neither have vitamines or radioactivity of any sort been shown to bear any influence upon the disease. In the case of these also, thorough studies have not been made. Deficient or improper diet has not been a feature in the histories; nor has essential improvement been recorded following regulation of diet.

Lues. Syphilis has been excluded in practically every case except that of Albers-Schönberg's where prolonged specific therapy had no effect upon the clinical picture.

Heredity. This is the causative factor. Four of the cases were blood relatives. Two others occurred in father and son. Its rarity would suggest that the trait is recessive. Another factor of significance is inbreeding. The 4 cases which occurred in one family hailed from the island of Heligoland where inbreeding for generations is reported to be common, and intermarriage is mentioned in the family histories of these cases. There is history of inbreeding on the mother's side for several generations in Alexander's case. The hereditary causative factor is assumed to be a primary mesenchymal dyscrasia leading to abnormal and excessive bone-building.

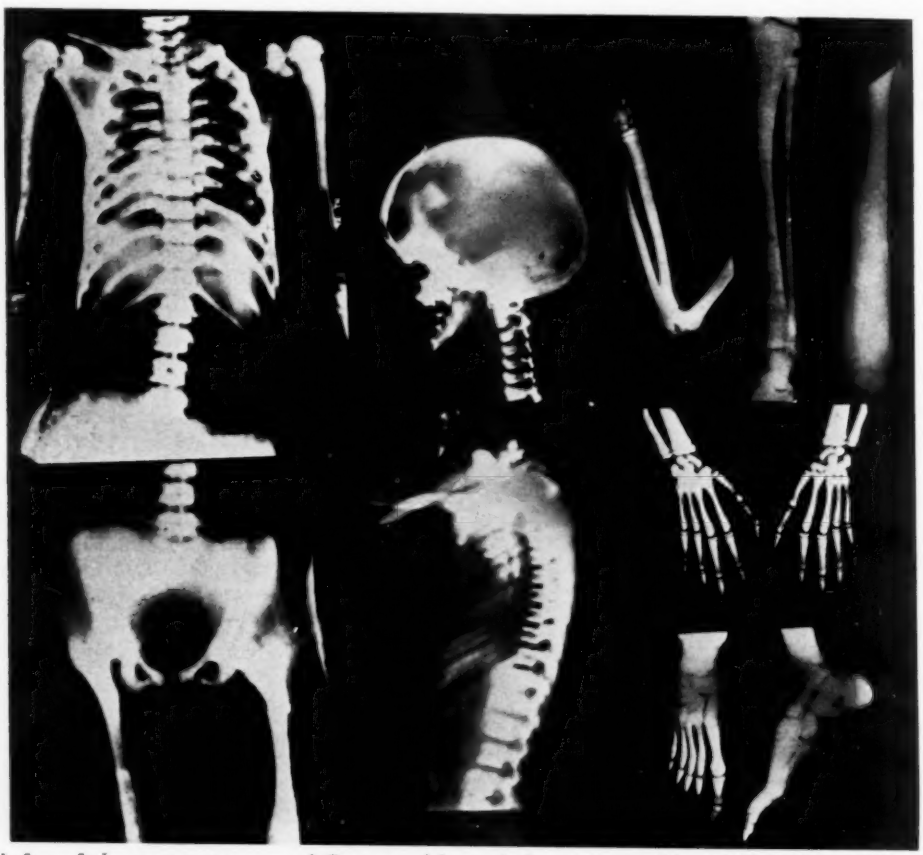

Fig. 6. A few of the roentgenograms of Case IV, girl, aged eleven years. The original films show much more detail. Transverse striations of the metaphyses of the long bones can scarcely be made out in the reproductions. A plaster case embraces the pelvis, both hips and one femur. Note recent fracture of femur.

PATHOLOGY

Fundamentally the pathology is a diffuse malformation of bone and cartilage manifesting itself as a disturbance of ossification. Grossly there is the increase of hard, cortical bone to more than twice the normal thickness, with condensation and broadening of the bone trabeculae, obliteration of the spongiosa by the encroaching compacta, and crowding of the marrow elements, often with replacement by fibrous tissue. The periosteum is undisturbed, the hyperplastic bone growth being entirely endosteal. The epiphyseal lines may be irregular and ragged, leading to malformations.

Microscopically the structure and texture of the cortex differs in no way from normal compact bone. The periosteum is normal. Nadolny's autopsy of a four-month child provided opportunity to study the disease in the growing body. This author describes microscopic evidence of bone building, the spongy portions rapidly becoming compact, and the medullary

spaces becoming obliterated. Hand in hand, she noted a fibrous metamorphosis of marrow with marked regression of the erythroblastic elements. There was no hemosiderosis. Osteoid tissue was practically nil. Schulze, examining the body of an eleven year old boy, found much osteoid tissue in the medullary spaces. The case of Clairmont and Schinz was thirty-five years of age. No osteoid tissue was found. Kraus and Walter describe medullary osteoid tissue at autopsy of a child of three years.

Nadolny studied the epiphyseal cartilages and found the ossification zone to be irregular and broadened with a profound disturbance of calcification of the cartilage ground substance, the medullary portion of the cartilaginous epiphysis presenting extensive calcification. In the adjacent bone medulla the cartilage cells were not properly demolished, leaving an irregular persistence of excess cartilage ground substance. Except for disturbance of ossification no abnormality was noted in the cartilage.

As a result of the generalized obliteration of the bone marrow the latter loses to a greater or less degree its hematopoietic powers. Consequent upon this there may be a metaplasia of hematoplastic elements into other organs, the spleen and liver resuming their fetal blood-forming function. This sequence occurs in other primary diseases of the bone marrow. So in osteopetrosis, depending upon the severity of the bone marrow destruction, one finds enlargement of the spleen, liver and lymph glands with metaplasia of blood forming elements, more often myelocytic. In the more severe cases, the blood picture and autopsy findings merge into the general pictures of the severe anemias and the leucemias.

SYMPTOMS AND CLINICAL MANIFESTATIONS

Fragility. Spontaneous fractures following trivial injury are one of the commonest symptoms. These involve only the long bones, most frequently the femora. The cause has not been established. It seems reasonable, however, that the increased mineral content of the bones diminishes their elasticity and that they consequently fracture easily for the same reason that the bones of the aged fracture more readily than those of childhood. Schulze found the bones to be of inferior quality in that they contained much osteoid tissue. Other observers, however, state that the dense portions are normal in structure and texture. No actual tests of strength and resistance of the affected bones or estimations of the mineral content have been made. As a rule, the fractures heal normally. Union is rapid in the very young. In older children it may be slow. Fracture of the neck of the femur in Alexander's case, an adult of forty-three, failed to unite.

Deformities. These are not infrequent, not only as the result of healing of fractures in malposition, but due to softening at the epiphyseal lines which Nadolny has shown to be due to disturbance of endochondral ossification. Bosses, coxa vara, scoliosis, rosary, deformity of the ribs and chest, and enlargement of the epiphyses are not uncommon.

Development. Practically all cases are physically underdeveloped. The epiphyses are late in appearing, the epiphyseal lines are slow to close. The fontanelles remain open until late. Walking, talking and dentition are delayed. The older children and adults are slender, frail, and underweight. There is no dwarfing of stature, the long bones attaining normal length. Unless there is a complicating hydrocephalus, mentality is not materially affected. No distinct disturbance of sexual development has been described.

Facies. There is a typical facial expression that accompanies the disease. Three of my cases were babies. Undoubtedly all of them were hydrocephalic. Their appearances were so similar that they might have been considered triplets. The expression differs from that of idiocy, mongolism, cretinism and achondroplasia, and may be described thus: The face is broad, the eyes are wide apart. They do not slant. The epicanthic fold is not thickened. The root of the nose is sunken, the tip is broad and turned up, the nares are round and far apart. The lips are thick. The mouth is not held open and the tongue does not protrude. The hair is abundant.

Withal there is a wrinkling of the skin and appearance of senility. In the older patients the suggestion of senility is augmented by the poor development of the alveolar processes and the absence of teeth.

Head. Hydrocephalus is common, particularly in the younger patients. There are prominent bosses. The head may be of abnormal shape, dolichocephalus and its opposite being described. It is almost invariably noted that the forehead is prominent. Labyrinthine deafness was a symptom in one case, paralysis of eye muscles in 2 others. Nystagmus occurs, and was present in Cases I and III. In the opinion of otolaryngological consultants this was of labyrinthine origin, although both cases were blind, hydrocephalic, and one was an albino. Blindness due to optic atrophy is not infrequent. The above group of symptoms is attributed to physical interference with function by overgrowth of bone. Autopsies on heads of patients with osteopetrosis have shown all sharp points rounded and all bony orifices narrowed. Such narrowing proceeds until the optic nerve, for instance, is pinched at its exit from the cranium, with resulting pressure atrophy.

Teeth. These are invariably bad. Dentition is late, the teeth are poorly formed and developed and rapidly become carious. In several instances infected teeth have led to suppuration and necrosis of the jaw. Four times the latter has been the cause of death, once as early as the fourth month of age. The dental manifestations are probably caused by a primary disturbance of calcification of the teeth rather than disturbed nutrition due to diminished blood supply. Whether or not this disturbance is limited to the mesodermal elements, or primarily involves also those of ectodermal origin has not been determined. While the teeth are equally poor in both the upper and lower jaws, it may be significant that necrosis has been limited to the mandible, where the arteries furnishing the blood supply to the teeth run an extended course within bone and are without collateral anastomoses. In Case IV, the lower jaw was poorly developed. The same condition is suggested by photographs of other cases collected from the literature.

Blood. Anemia is the commonest symptom. The blood picture varies from normal or the mildest secondary anemia to grave anemia leading to death. It may by degrees pass over to that of leucemia in one of its various forms. Most of the patients have palpable lymph nodes. Enlargement of the liver is common. The spleen may be just felt, or present as a huge tumor, often of board-like consistency. Splenomegaly was the chief complaint in more than one of the cases.

ROENTGEN FINDINGS

The roentgen findings are unique. The entire osseous system is involved. The bones are exceedingly dense. Very little or no medullary structure can be distinguished through the homogeneous compact cortical density except frequently at the distal portions of the shafts of the long bones or in the centers of the flat and small bones. The normally pneumatic structures of the head are represented by solid dense bone. Club-like thickening of the posterior clinoid process is described by most observers. This occurs to a greater or less degree and is merely a part of the generalized process involving the skull by which all angular points and bony prominences become smoothed and rounded. The epiphyses are slow to show ossification in infants and epiphyseal lines remain unclosed into early adult life. Coxa vara, scoliosis, rosary, and other epiphyseal deformities are by no means rare. Irregularity of the epiphyseal lines somewhat resembling a Trümmerzone was disclosed by the roentgenograms of Nadolny's case. There is frequently clubbing of the ends of the long bones, both proximal and distal, most often involving the humeri and femora. Striations occur most often in the distal portions of the shafts of the long bones. These are alternating rings or transverse bands of exceedingly dense and more nearly normal bone, suggesting that the disease process might exhibit cycles of activity during one of which compact bone is grown, followed by a period of bone formation of normal density. They are not manifest in early infancy but become evident in most instances as the long bones grow in length. Similar concentric rings or layers of com-

pact osseous substance alternating with normal density may be seen in the bones of the hands and feet. The pelvis may be dense in its entirety, although the centers of the bones are not infrequently uninvolved. Fractures, old and recent, are numerous. As a rule the roentgenogram will reveal more fractures than are elicited by the history.

DIAGNOSIS

Almost without exception this has been made from the roentgenogram upon which it resembles no other known condition. A few cases were discovered at autopsy. The diagnosis can be made from the clinical picture, however, as osteopetrosis is a malady *sui generis* distinct from any other disease. Case IV was so diagnosed. Differentiation from generalized reactive osteosclerosis secondary to leucemia might offer some difficulty. Doubtless chronic phosphorus poisoning with osteosclerosis and necrosis of the jaw could closely simulate osteopetrosis. In such case the diagnosis would depend upon the history. Generalized osteosclerosis of other types should offer little difficulty. Localized osteosclerosis need not be confused with osteopetrosis if the entire skeleton be studied by the roentgen ray.

Differentiation from other bone dystrophies is not perplexing. The general density of the bones is increased in achondroplasia. However, the long bones are not of normal length, the medullary canals are not encroached upon, and the diseases are entirely dissimilar in other respects. Thickening of the bone in congenital lues is largely periosteal as well as endosteal and there is often an accompanying destructive process. In osteitis deformans the deformities come on late in life and the increased density of the bones is not homogeneous, but interspersed with areas of reduced density. The striations are longitudinal rather than transverse.

Multiple spontaneous fractures occur frequently in active rickets, osteitis fibrosa cystica, osteomalacia and osteopsathyrosis. In all these diseases the bone density is decreased from the normal. Healed rickets presents no such degree of bone density as occurs in osteopetrosis.

In the past the commonest error clinically has been to regard osteopetrosis as active or late rickets. Numerous cases in the literature have been so mistaken. Three out of my 4 cases had been pronounced rickets. To superficial examination the diseases are similar in many respects. Both present fractures, underdevelopment, epiphyseal irregularities, late dentition and imperfect teeth. They are, however, unlike in other respects and present no resemblance whatever on the roentgenogram.

COURSE AND PROGNOSIS

It is a chronic malady. Frequently the course is rapid and progressively fatal. The most severe cases may die *in utero*. In many instances death occurs at or soon after birth. In others the progress of the disease seems arrested. The severity, of course, depends upon the development of the serious secondary manifestations without which the outlook for life is good. The prospect of eliminating the disease is hopeless. The fractures heal. Hydrocephalus leads to mental deterioration. Optic atrophy is the forerunner of blindness, but does not destroy life. Suppurations and progressive anemia may go on to death. A leucemic picture signifies a bad prognosis. Albers-Schönberg's patient with severe anemia was observed to maintain the same state of health for eighteen years.

TREATMENT

This is mostly prophylactic. Guard the patient from trauma and observe rigid dental hygiene. Avoidance of substances known to promote bone growth, such as arsenic, calcium, phosphorus and cod liver oil is advocated. The anemia may be combatted with iron preparations. Marriage of persons having the disease to blood relatives is interdicted.

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TECHNIQUE FOR ROENTGENOLOGICAL STUDY OF THE COLON*

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IN spite of the frequent and urgent warnings by many of the pioneers in roentgenology, the colon has not yet received due recognition in the routine barium meal examination. The clinical evidence presented in colon pathology is frequently meager. The proctoscopic examination is necessarily limited to a small area of the colon. The fecal examination except in a few specific lesions is also limited and often-times misleading. The physical examination will always maintain a high average of inaccuracy and incompleteness. Therefore, the responsibility of obtaining a reliable, accurate and complete report of colonic pathology or abnormality must for a long time to come, at least, rest upon the roentgenologist.

While the colon injection alone will usually reveal most of the colon pathology, a thorough understanding of the exact situation can be learned only by the combined method of frequent and careful observation of the ingested meal during its progress through the colon, this to be followed by the colon injection after a thorough preparation. By frequent observation of the barium meal, one is often given a hint at least of pathology, or of abnormal conditions existing. The roentgenologist has an opportunity to note the motility, or lack of it, in the different portions of the colon; the size, shape and position, or varying positions of the colon; signs of adhesions or obstructions; possible filling defects, or other lesions, as colitis, diverti-

* Read at the Twenty-seventh Annual Meeting, American Roentgen Ray Society, Detroit, Mich., May 17–21, 1926.

culosis, etc. With this previous information the observer is able to decide the special procedure to follow in the colon examination by the enema.

Our routine preparation is to give the patient at least three cleansing enemas, one or two hours before the colon injection. The patient is given the enemas between seven and seven-thirty in the morning, is allowed to eat his breakfast and reports at the roentgen-ray department between nine and ten o'clock. For the injection, an aluminum enema can is used, with the outlet in the bottom. A rubber bulb is placed about mid-way in the tube, the tubing leading from the can to the bulb being of large size, which, with the rubber bulb, will enable one to keep the barium from settling and clogging the tube. The usual sized glass rectal tube (well lubricated) is used, which the patient is required to insert for himself. This precaution often saves the roentgenologist an unpleasant experience. Then also, the roentgenoscopic room is dimly lighted and if the examiner inserts the tube, it will require additional light thus spoiling his eyes for the examination and even then he may give the patient a painful injury. If the patient inserts the tube he will not hurt himself, and he will be in a less nervous attitude, consequently in better condition to coöperate with the roentgenologist during the examination.

The vehicle used should be a mixture in which the barium is well suspended and free from lumps. Gum tragacanth has proven to be a most satisfactory medium in which to hold the barium in suspension. At least 4 ounces of barium sulphate should be used to a quart of solution and we have found it advisable after the mixture has been thoroughly triturated to strain it through a fine sieve.

FIG. 1. Carcinoma of the ascending colon, partially obliterated by the overlying flexure and terminal ileum.

FIG. 2. Same case as Figure 1 taken in a right oblique position with the lesion fully exposed.

With the enema can about two feet above the level of the table, the tube in place and with the patient lying comfortably on his back, the solution is allowed to flow. If the barium enema does not start readily or at any time seems to stop, by shutting off the tube above the bulb and compressing the bulb, the flow can be easily started again.

Observation should commence as soon as the enema begins to fill the rectum. Unless this is done a lesion low in the ampulla

may be hidden by the filling of the healthy rectum above. In the normal ampulla the Houston's folds (two on the left side and one on the right) should be clearly seen. The normal rectum when distended with the enema should measure not over 3 inches in diameter and from 5 to 6 inches in length. The barium stream hesitates for a short time as it reaches the rectopelvic junction, then passes quickly through the pelvic loop and hesitates again at the ileopelvic junction. If the pelvic loop is free, it should rise to near the level of the interiliac line; if it is not free, an effort should be made to induce it to rise. Manipulation under the screen of this portion of the colon is difficult as it lies nearly under the pubic arch. To obviate this condition, the head of the roentgenoscopic table may be lowered, or the patient rotated to the right or left.

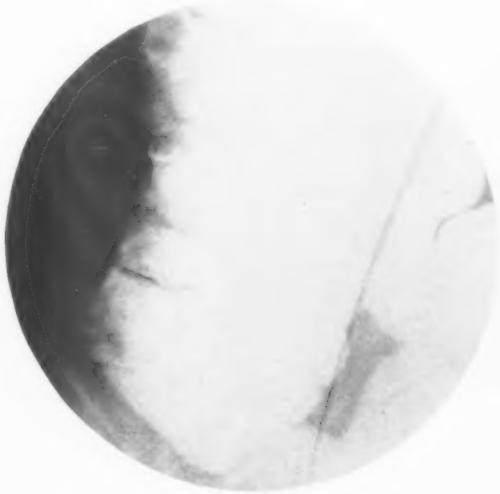


Fig. 3. Apparently normal cecum.

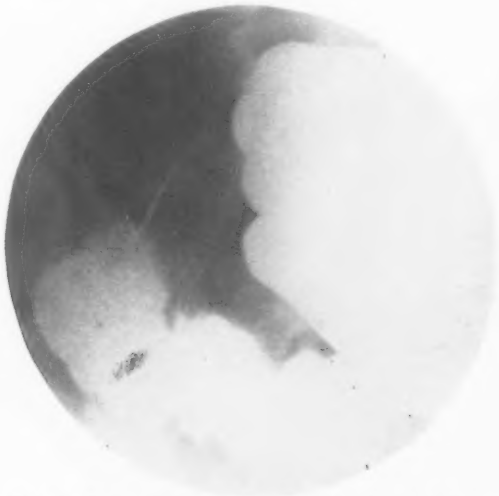


Fig. 4. Same case as Figure 3, taken in an oblique position, with the tip of the cecum exposed by the hand.

From the rectopelvic junction to the splenic flexure the passage of the chyme is rapid. If this portion of the colon is spastic, its caliber is small, often no larger than a pencil, and the progress of the barium is correspondingly rapid. At times a localized spasticity involving but a few inches of the colon may be noted. This condition should be considered indicative of some inflammatory process such as diverticulitis.

An apparent delay is always noted at the flexures, especially the splenic, but by rotating the patient to the left oblique position, or by separating the arms of the flexures with the hand under the screen, it will be noted that there is a wide loop extending from front to back and that under normal conditions there is no actual delay at this point.

After the barium column has rounded the splenic flexure, the patient will normally experience less difficulty in retaining the enema. Occasionally while the distal colon is being filled, there will be a mass peristalsis observed which will cause the patient some discomfort. The second apparent delay will be observed at the hepatic flexure, where a smaller backward loop exists. Care-

Fig. 5. Same case as Figures 3 and 4 in right oblique position.

ful observation should be made at this point, by rotating the patient or mechanically separating the arms of the flexure (Figs. 1, 2, 3, 4 and 5), observing if there are any irregularities or any evidences of adhesions, bearing in mind that one of the indirect signs of gall-bladder lesion is a deflection upward and inward of the hepatic flexure by hepatic adhesions.

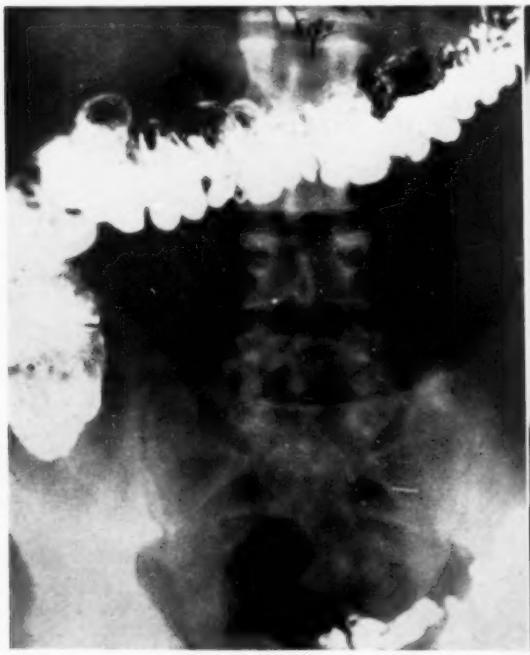


FIG. 6. Anterior view of apparently normal cecum.

FIG. 7. Same case as Figure 6 showing an unusual arrangement of the terminal ileum from adhesions.

FIG. 8. Same case as Figures 6 and 7 taken in the right oblique position revealing the retrocecal appendix.

The ascending colon usually fills easily without any particular distress to the patient. Special care should be taken to round out the cecum noting carefully its movability, its size and position. In many instances the cecum will be found to be very movable. Oftentimes it can be moved from without inward at least 3 inches; or upward from 3 to 4 inches.

Great stress should be placed upon the observation of the tip of the cecum, as many times it is found to be inverted, or tipped backward and upward by an adherent appendix, and valuable information may be obtained concerning the appendix, even though it cannot be visualized (Figs. 6, 7, 8, 9 and 10).

By giving utmost attention to every portion of the colon as the barium enema is administered, one or more of the various signs of carcinoma or other forms of tumor should be detected (Figs. 11, 12, 13, 14 and 15). As early as 1914 Case gave six

FIG. 9. Low lying dilated cecum.

FIG. 10. Same case as Figure 9. By the use of the spoon a rectrocecal appendix is exposed.

FIG. 11. Marked ileac delay with the gas filled colon, one of the signs of an obstructive lesion of the colon.

FIG. 12. Same case as Figure 11 showing a lesion of the splenic flexure.

FIG. 13. Same case as Figures 11 and 12 in a left oblique position.

signs of carcinoma which are as follows: (1) Exaggeration of colonic anti-peristalsis, giving the appearance of "peristaltic unrest" to the barium content above the site of the lesion, with arrest or hindrance in the onward progress of ingested barium; (2) arrest or noticeable hindrance in the ascent of the barium column when giving the barium enema; (3) coincidence of a palpable tumor with a point of hindrance to the barium meal or barium enema; (4) a filling defect in the shadow of the barium-filled colon. Frequently the filling defect is digitated, indicating a cauliflower growth. At times it may be annular so that one may diagnose an annular carcinoma; (5) the colon is often distended by gas, and gas collections are seen surging backward and forward, owing to the alternations of the peristalsis or anti-peristalsis; and (6) marked ileal stasis when the neoplasm involves the cecum, ileocecal valve, or the first part of the ascending colon.

As soon as the barium is seen to pass back through the ileocecal valve the enema should be discontinued and the tube removed. With the colon filled to its entirety there is still an opportunity to re-inspect any suspected area, and by changing the patient's position to right or left oblique, or by lowering the head and by use of the gloved hand or wooden spoon under the screen, a thorough check can be obtained of the entire colon. The suspected

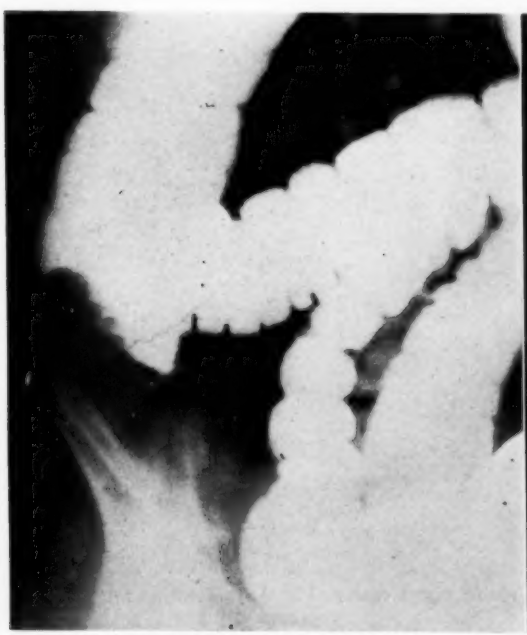


FIG. 14. Partially hidden lesion of the cecum.

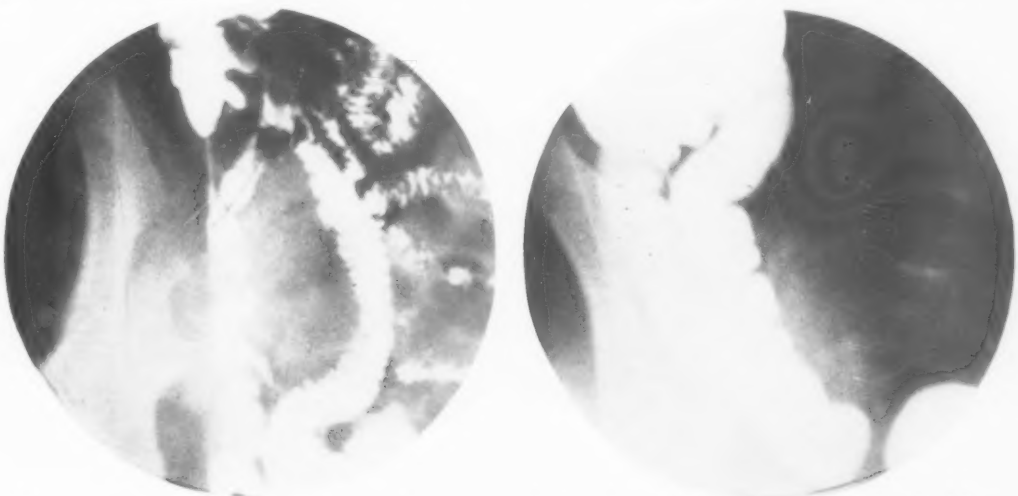
FIG. 15. Same case as Figure 14 taken in a right oblique position revealing the extent of the lesion.

regions should then be roentgenographed while the patient is still on the roentgenoscopic table where the spoon or hand can be used to separate the loops of the colon, while under direct observation, bringing the suspected area into relief (Figs. 16 and 17).

Fig. 16. The colon injection revealing what appears to be a small appendix.

Fig. 17. Same case as Figure 16 with the ampulla and stomach filled revealing the extent and position of the appendix.

The patient should then be placed on a Bucky diaphragm and a large film made covering the entire abdomen. Occasionally stereoscopic films will be indicated. Additional smaller films of the suspected area may be advantageous with the patient placed in either the anterior, right oblique or left oblique position as the case may require, in order to demonstrate more clearly the particular abnormality (Figs.



Figs. 18 and 19. Adhesions between the long narrow lumened appendix and loop of the terminal ileum.

18, 19 and 20). After this the patient should be allowed to evacuate the enema, and in cases where the previous roentgenoscopic examination is not entirely satisfactory he should be observed for the second time on the roentgenoscopic table.

FIG. 20. Same case as Figures 18 and 19 with the ileum empty.

It is noticeably true that after the evacuation, additional information can be obtained in relation to points of obstruction, motility of the colon, or even filling defects which may be seen better after the larger part of the enema is disposed of. When new information is obtained additional roentgenograms should be made as a double check. It is sometimes advisable to make a later observation at twenty-six or fifty hours, as these observations will be found helpful in demonstrating some conditions, such as diverticulosis or a patent appendix.

In 1914 Case suggested that at times the filling of the colon with air could be made useful for diagnostic purposes. At different intervals this method has been advocated by various men and in some cases has without doubt proven helpful. In some instances we have used this method during the roentgenoscopic observation after the patient has evacuated the barium enema. The injection of air assists materially in the demonstration of the number and distribution of multiple diverticula of the colon that have been filled with the barium from the ingested meal. Stereoscopic films made at this time will often be of particular interest.

It has been stated that there is at least 20 per cent error in the roentgen findings of colon pathology. In our opinion, if the colon receives a thorough and painstaking examination, repeating the test in all obscure instances where pathology is indicated, or in cases of doubt, this high percentage of error can be greatly reduced.

OBSERVATIONS ON SOME UNUSUAL CASES OF JOINT TUBERCULOSIS

BY C. W. BLACKETT, M.D.

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IN discussing the value of the roentgen ray in the diagnosis of tuberculosis of the hip joint, Whitman says that roentgenograms are of use in demonstrating deformity rather than in making an early diagnosis—the only constant indication of disease being atrophy of the shaft of the femur and a blurred outline, "fogginess," of the parts involved. Baetjer and Waters state that after an indefinite stage in which no evidence of disease appears, except some fluid and periarticular swelling, the roentgenogram of the joint becomes hazy and indistinct and that this is typical of joint tuberculosis. During the last year or two, we have seen a few cases which we believe to be tuberculous, but which show deep pockets of bone destruction extending from a joint cavity into the bone, with very little atrophy and none of the blurred outline or "fogginess" so common with tuberculous joints.

Tuberculosis of the bones is practically always a blood borne disease although the infection may occasionally be secondary to tuberculosis of the synovial membrane of a joint or it may conceivably be carried by the lymph stream. It is a disease of cancellous bone and of epiphysis and rarely involves the shafts of the long bones. The process usually begins by the deposition of tubercle bacilli in the very vascular bone near the epiphyseal line. A ring of cells is produced about these bacteria and there is a congestion and swelling of the surrounding tissue. Thus a miliary tubercle is formed which extends and unites with other similar tubercles. Granulation tissue develops and the bony trabeculae are gradually absorbed. A little later the cells in the center of the tubercle gradually soften and become caseous. The process may heal at this point with the formation of a connective tissue scar but it usually goes on until it perforates through the cartilage or through the bone just outside the cartilage.

While the disease is still confined to the bone an irritative synovitis usually develops with congestion and hypertrophy of the joint membranes and an increase of the fluid in the joint. There may even be some fibrin formation. When the tuberculous granulations perforate into the joint, a true tuberculous synovitis develops with the formation of granulation tissue and tubercles in the joint membranes. The granulations grow up over the cartilage, eroding it as they go, and with the destruction of cartilage the bone is exposed. This bone is soon destroyed by pressure and friction and the joint cavity becomes filled with detritus and is turned into a large abscess cavity. The joint capsule finally perforates and sinuses are formed allowing secondary

FIG. 1. Case 1. Tuberculous destruction in the neck of the femur and deep pockets extending into the bone from the acetabulum.

infection to take place. The disease is one of destruction with very little new bone production until secondary infection takes place.

Numerous writers have described the changes seen in the roentgenograms of cases of tuberculous joints. Commonly, the first abnormality noted is a slight periarticular swelling and a suggestion of fluid in the joint cavity. This may correspond with the irritative synovitis which is present before the true tuberculous infection of the joint itself occurs. The next change is the one usually described as typical of tuberculosis. The whole joint becomes slightly hazier than normal and the surfaces of the joint and the epiphyses are not clear cut. The appearance suggests a poor film but the bone detail of the rest of the film is good. A little later the whole joint takes on the characteristic "muddy" appearance with a loss of the bone outline and a destruction of the cartilage and the bone.

None of the somewhat atypical cases which we have seen were examined in the irritative stage for all had developed some bone destruction when first observed. In these joints there were several pockets of bone destruction extending from one-quarter to three-quarters of an inch into the bone from the joint cavity. There was usually some slight lime atrophy but the joint surfaces of the bones were clear cut and there was none of the blurring and fogginess seen in the early typical cases. In some of these cases the destructive process has developed, and at a later stage the joint has become muddy and foggy.

FIG. 2. Case II. Pockets of destruction about the hip joint.

FIG. 3. Case II. Extensive destruction two years later.

CASE I. This case was a boy about five years old who was examined because of a limp and some slight spasm of the hip. The first plates showed a small area of rarefaction about one-quarter inch in diameter on the under surface of the neck of the femur back of the epiphyseal line. There was no involvement of the epiphysis but there was a very slight lime atrophy. No blurring or fog was seen. A second examination two years later showed some atrophy of the femur and some loss of lime salts through the whole bone. The area of rarefaction seen in the neck of the femur was about the same as it was two years before. This time,

however, there were several pockets one-quarter to one-half inch in depth extending from the acetabulum into the bone of the pelvis. The head of the femur was intact and its outline was sharp and clear with none of the fogginess seen in the typical tuberculous joint. Six months later the process had become so advanced that the whole head and neck of the femur were destroyed and an abscess had formed. Pus from this abscess produced tuberculosis in a guinea pig.

CASE III showed some atrophy of the shaft of the femur and a large erosion on the ilium above the acetabulum. There was no fogginess or muddiness in the joint. This case was followed for about one year. During this time the destruction in the ilium increased until a very large deep pocket was found in the bone above the joint. The epiphysis of the head of the femur enlarged but did not undergo destruction and there was never any marked fogging or blurring in the joint.

FIG. 4. Case III. Destruction of the ilium above the acetabulum.

FIG. 5. Case III. Increased destruction one year later.

CASE II. This case was similar to the first. When first seen there were two areas of rarefaction in the neck of the femur just back of the epiphyseal line, together with three pockets extending from the acetabulum into the ilium. The epiphysis of the head of the femur showed a slight erosion on its upper outer corner. The outlines of the joint surfaces were clear cut with none of the typical "fogginess." A second examination two years later showed that the pockets in the ilium and neck of the femur were much larger. The outline of the upper end of the femur was clear cut and there was no fogginess.

CASE IV showed a marked destruction of about one-quarter of the upper epiphysis of the humerus. A sharply defined crescentic area of bone destruction was seen on the films. The outlines of the joint surfaces were clear cut and there was no fogging or blurring. This case was operated upon and a microscopic examination showed tuberculous granulations.

CASE V showed a very marked erosion of the left side of the symphysis pubis with a marked destruction of the pubic bone. No new bone was found. The right side of the symphysis was clear cut and there was no fogging or blurring. The

picture really looked like an osteomyelitis of the pubis but microscopic examination after the operation showed tuberculous granulations.

The study of these and a few other similar cases has brought to our attention this one fact—that there is a type of joint tuberculosis which shows deep pockets of bone destruction, but which also shows very little blurring or fogging of the joint outlines themselves.

FIG. 6. Case IV. Tuberculosis of the upper epiphysis of the humerus.

FIG. 7. Case V. Tuberculosis of the symphysis pubis.

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PATHOLOGY OF BREAST CANCER WITH SPECIAL REFERENCE TO METASTASIS*

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BUFFALO, NEW YORK

IN the time allotted to this paper one can hardly be expected to cover the subject of pathology of breast cancer. I will therefore confine myself to certain aspects of the subject which appear to be of importance, and refer you, for details, to such excellent works as Ewing's Neoplastic Diseases,[1] Deaver and McFarland, The Breast: Anomalies, Diseases, Treatment,[2] Handley's Cancer of the Breast,[3] and Bloodgood's article in Binnie's Surgery on Lesions of the Female Breast.[4] I wish to acknowledge at this time, my indebtedness to these authors.

ETIOLOGY

A specific etiologic factor for breast cancer has not been found, although in the past few years a number of investigators have made claims of having cultured organisms from mammary carcinoma which they believe to be specific. None of these claims have been substantiated by other research workers.

In certain strains of mice, inbred from cancerous parents, a malignant neoplasm of the breast occurs spontaneously in a large percentage of the females. Very careful and laborious investigation has failed to discover any extrinsic cause for the appearance of these tumors. There can be little doubt that heredity plays an important rôle in the spontaneous occurrence of cancer of the breast in mice. In our experience with many thousands of these inbred mice, we have never observed cancer in the breast of the male. It is probable that the conditions favorable for the origin of cancer are not present in this sex. We have experimental evidence which is interesting in this connection. We know that if we ovariectomize the females before they are twenty days old, spontaneous tumors do not occur.

An important contribution in relation to the experimental production of cancer of the breast has been made recently by Bagg[5] of the Memorial Hospital, New York. The experiments were designed to test the relation between functional disturbances of the breast and the incidence of mammary carcinoma in mice. An inbred strain of animals of a known low rate tumor incidence was used. The animals were divided into two groups; the one used for control was allowed to breed and to suckle the young normally. In the other group the animals were bred very young and the litter removed immediately after parturition. The mothers were remated and the procedure was continued for as many as nine to eleven consecutive litters. The removal of the young prevented the proper drainage of the breast, which resulted in marked stasis of the mammary ducts. The result of these experiments showed that the control animals gave 5 per cent of spontaneous tumors, while the experimental group gave 87 per cent. Bagg believes that stagnation plays an important rôle in the production of cancer of the breast. After reviewing these experiments, one is led to consider the importance of a superimposed irritant combined with a hereditary tendency and its relation to the development of cancer. It might be of interest to call attention to the fact that cancer of the breast is second in frequency amongst English women, while it is next to last in Japanese women. It is not known whether the Japanese women suckle their young more consistently than do the English. Bagg's experiments point out that statistical data would be of value in this connection.

The relation of cancer to chronic inflammatory lesions of the breast is not definitely known. However, in the microscopic examination of more than 2,000 breast carcinomata I have found evidence of chronic inflammatory changes accompanying the malignancy in over half of them. The

* Read at the Eleventh Annual Meeting, AMERICAN RADIUM SOCIETY, Dallas, Texas, April 19 and 20, 1926.

lesion called chronic cystic mastitis is often intimately associated with the histologic picture of carcinoma.

The age factor is interesting. I was able to find only 10 cases under the age of twenty-five among more than 14,000 breast cancers reported in the United States Census. We may say that the malignancy curve for breast cancer begins at about the age of twenty-five and increases sharply at every succeeding decade. The greatest number of cases occur between forty-five and sixty-five and it is therefore well after the menopause that the hazard from breast cancer becomes greatest. The frequency of the occurrence of this lesion increases proportionately, in relation to the number of living females, as age advances. The figures roughly are as follows:

25–35	3 per 100,000
35–45	17 per 100,000
45–55	38 per 100,000
55–65	53 per 100,000
65–75	76 per 100,000
75 and over	105 per 100,000

An important fact to be remembered in regard to age is this; the younger the person, the more malignant are the manifestations of this disease.

PATHOLOGY

From an anatomical standpoint there can be but two types of carcinoma springing from the mammary gland: (1) those originating from the epithelium of the acini, and (2) those from the epithelium lining the ducts. To these may be added carcinomata originating in deep-lying skin glands and those that may spring from the epithelium lining cysts.

But from the histological standpoint there can be three fundamental types of cancer of the breast, viz., parenchymatous, adenomatous and duct cancer. Any of these may have a preponderance of stroma and become scirrhous. Also, mucoid change may take place in the cells of the neoplasm and we then have gelatinous cancer.

By far the most practical pathological classification for clinical purposes is that based upon the gross characteristics of the neoplasm, for they are of especial value in regard to prognosis and treatment.

Given in the order of the frequency of occurrence, the following seems a simple and practical classification of breast cancer. (1) Scirrhous carcinoma; (2) medullary carcinoma; (3) duct carcinoma; (4) adenocarcinoma, and (5) gelatinous carcinoma.

A brief review of these types will be of value.

(1) *Scirrhous Carcinoma.* This is the most common variety of cancer found in the breast. Its name is derived from its stone-like hardness which is due to the preponderance of connective tissue. As a rule, scirrhous cancer occurs in the later decades of life. It is most commonly circumscribed and may vary in size from a hazel nut to a mass filling the entire breast. Its course is slow but progressive. The breast is flat and the nipple usually retracted. Scirrhous carcinoma frequently originates in areas of chronic mastitis. Although the course is usually slow, metastases may occur early and be extensive. Occasionally scirrhus presents itself in the form of a diffuse sclerosis, characterized by a marked proliferation of fibrous tissue, in which are sparsely distributed, small groups of cancer cells.

(2) *Medullary Carcinoma.* This is usually a small soft tumor and takes its origin from the acinar epithelium. The history is of a growth of a few weeks' duration. Upon clinical examination a small movable nodule is found near the margin of the breast. It is never encapsulated, grows rapidly and has a marked tendency to metastasize. I have seen this type of tumor no larger than a walnut and freely movable, showing extensive metastases in the axilla. Medullary carcinoma appears usually in younger women and is the type that occurs during pregnancy.

(3) *Duct Carcinoma.* This type arises from the epithelium of the interlobular and larger ducts. It usually begins near the nipple and thus affects the central portion of the breast. Eventually it invades the entire organ and may show marked fibrosis. The entire breast may be contracted into a cancerous mass, and retraction of the nipple is an early sign. Although duct carcinoma commonly affects the central portion of the breast, it may occur in any quadrant. This type of breast cancer is

comparatively benign and metastases either do not occur, or they appear very late.

(4) *Adenocarcinoma.* Adenocarcinoma originates commonly in cysts, especially cysts of chronic cystic mastitis. It is usually a single circumscribed bulky growth but may frequently be multiple. The lymph nodes remain free from metastases for long periods and therefore this type should be classified as relatively benign.

(5) *Gelatinous Carcinoma.* Gelatinous carcinoma is usually an adenocarcinoma in which either the cells or the stroma have undergone mucinous degeneration. Although this type has little tendency to metastasize, yet when it does, the metastatic nodules have the same tendency to undergo mucoid change. Gelatinous carcinoma shows marked infiltrative characteristics and has a great tendency to recur after removal.

The scirrhous and medullary types comprise the great majority of breast malignancies. Both are characterized by a marked tendency for early and extensive metastases and are therefore the most malignant types.

Duct carcinoma comes next in frequency and is a bulky tumor, usually situated in the central portion of the breast. It may be soft or hard and has little tendency to metastasize.

The adenocarcinoma and gelatinous types are comparatively rare and together with the duct carcinoma may be classified as relatively benign.

Since we have chosen to describe the pathology of breast cancer from a clinical classification, I think it would be advantageous to include here the *inflammatory carcinoma* so well described by Lee.[6] This clinical type does not appear to be limited to any single anatomic variety but is the result of extensive invasion of the skin vessels by metastatic cells. There is diffuse enlargement of the breast, in which a rather ill-defined tumor may be mapped out. The tumor is soft in consistency and usually occurs in pendulous breasts. It grows with exceeding rapidity, filling the entire breast in a few weeks. There are inflammatory manifestations in and about the breast. The overlying skin is reddened and brawny. The axillary nodes become involved early. I call attention to this type of breast cancer especially because it is not amenable to surgical treatment and the only hope for relief is by means of radiation.

PROGNOSIS FROM MICROSCOPIC EXAMINATION

In the early days of routine microscopic examination of tumors, it was thought that much could be determined by histologic study in regard to the degree of the malignancy of the neoplasm. There was no standard picture upon which to base the assumption, but it depended in general upon varying degrees of anaplasia of the tumor cells and the frequency and the character of mitotic figures. However, experimental transplantation of animal tumors soon showed that there must be some fallacy in this assumption, for often primary tumors which showed a high degree of anaplasia, failed to grow when transplanted, although, on the other hand, tumors with little or no anaplasia were frequently successfully transplanted. Also, many tumors diagnosed microscopically as highly malignant, proved, by their subsequent clinical course, not to be so. Thus the profession became skeptical as to the value of the prognosis based upon microscopic examination. However, MacCarty[7] and his coworkers have made numerous studies, correlating certain histologic changes with the postoperative longevity of the patients, which appear to show that the presence of hyalinization, lymphocytic infiltration and differentiation of cells are evidence of favorable prognostic value. More recently Broders[8] has suggested the classification of cancer tissue according to the degree of malignancy, as estimated by loss of differentiation and increase of reproductive characteristics. Following this line Greenough[9] has made a study of a series of 73 cases of breast cancer. Without previous knowledge of the clinical outcome of these cases, he grouped them, according to the degree of differentiation found in the histologic sections, into three groups, viz., low malignancy, medium malignancy and high malignancy. In comparing these with the subsequent clinical history of the cases, he found that Group 1 gave 68 per cent

cures, Group II gave 33 per cent and Group III gave no cures. The picture of high malignancy was based upon absence of secretory vacuoles, variation of the size of cells and nuclei, hyperchromatism and the presence of mitosis. Wood[10] has also reported upon 100 cases of breast carcinoma studied histologically to determine if there is any relation between morphology and prognosis. His results show that cell differentiation has some apparent relation to the degree of malignancy, but that in the cases studied, hyalinization and the presence of lymphocytes had little influence upon the prognosis. Personally, I do not think that we should rely solely upon the histologic picture as an indication for prognosis, for many other factors enter into the problem which I think are more important, for instance, the age of the patient, the resistance of the patient, the location of the lesion, the duration of the disease, etc.

METASTASES

Metastases may be defined as the implantation and growth of malignant cells at some distance from the primary tumor. It is important to know as much as is possible concerning the mechanism of the transport of malignant cells. There are two possible channels by which cells may be carried to distant parts; the blood vessels and the lymph vessels.

Cancer cells may enter the circulating blood in four ways: (1) by direct erosion through the wall of a vein situated in the tumor mass; (2) proliferation of tumor cells in the perivascular lymphatics with erosion into the vein at some distance from the tumor; (3) by involvement of a vein lying close to a metastatic lymph node that is breaking down, and (4) cancer cell emboli that have reached the lungs and have become established may erode into a neighboring vein, thus having access to the general circulation. Naturally, with the exception of the pulmonary veins, the entrance of malignant cells into the venous circulation would give rise to metastatic deposits in the smaller arteries of the lungs. Let us discuss first the frequency of embolic breast cancer metastases occurring in the lungs. Secondly, let us consider the work of Schmidt in connection with the fate of embolic carcinoma cells carried to the pulmonary vessels.

Secondary involvement of the lungs in breast cancer except by way of the pleura, is very rare. When lung involvement is found at autopsy it is nearly always associated with lesions either in the pleura or in the peribronchial lymph nodes.

The chief argument for metastases occurring by the way of the blood stream is based upon the frequency of metastatic deposits found in the bones, sometimes at points far removed from the primary lesion. However, when we remember that the majority of metastases from breast cancer occur in bones that are in the immediate vicinity of this lesion, it becomes difficult to explain how and why cells obtaining entrance to the general circulation would lodge and grow in these particular bones. It is also well known that bones below the elbow and knee are rarely affected.

In regard to the fate of embolic carcinoma cells which have involved the pulmonary vessels, we would call attention to an extremely important piece of work done by Schmidt[11] of Marburg. He made very careful microscopic studies of the lungs of 15 cases of cancer. It so happened that the primary lesions in the cases studied were all in the abdominal cavity. In all of these cases, Schmidt found cancerous embolism of the small pulmonary arteries. To the naked eye, the lungs usually appeared to be free from disease. Histologic examination showed that many of the smaller arteries contained cancerous thrombi. These thrombi appear in various stages, evidently corresponding to their age. Some are composed of fresh cancer cells, while in others many of the cells, especially those at the center, show signs of degeneration. Organization of the thrombus may take place with subsequent fibrosis in which may be seen the remnants of degenerated cancer cells. Schmidt remarks that at least in abdominal carcinoma, embolism of the small arteries of the lungs occurs very frequently but that only a small proportion of these emboli give rise to metastatic tumors. Most of the embolic cells are either destroyed or rendered

harmless by encapsulation. Thus we see that probably the great majority of cancer cells which may find their way into the venous circulation are stopped or destroyed in the smaller arteries of the lungs. It is conceivable that occasionally the cells in these emboli will proliferate and form a nodule which may grow into a neighboring vein, and thus be swept into the general circulation.

DISSEMINATION

Handley divides metastatic dissemination into two main classes, viz., external or parietal, and internal or visceral. The external dissemination includes (1) skin, subcutaneous fat and muscle, (2) deep fascia, and (3) bones. The internal dissemination comprises the involvement of the thoracic and abdominal cavities. The main channel of dissemination is the lymph vessels of the deep fascia. Extension into the overlying skin and underlying muscles takes place through lymph radicles which drain these areas and empty into the deep fascial plexus. The bones are involved by permeation through the periosteal lymphatics.

Extension takes place first from the edges of the primary focus by the infiltration of malignant cells into clefts and spaces of the surrounding tissues. This comprises a zone in the immediate vicinity of the tumor mass. Subsequently these infiltrating cells penetrate the medium sized lymph vessels and continue to grow within their lumina, forming a continuous cord of cancer cells. The cells in the proximal portion proliferate and distend the walls, thus setting up a reactive inflammatory condition which may destroy the contained cells and ultimately become a fibrous cord. Meantime cells continue to proliferate along the terminal portion of the invaded lymphatic vessels and as these enter the larger ones emboli are broken off and are swept along with the lymph current and lodge in the neighboring lymph node. To the process of continuous growth within the lymph vessels, Handley has given the name permeation, while to that which takes place in the lymph stream of the larger vessels, lymphatic embolism.

Thus we may visualize parietal dissemination as follows: Considering the primary focus as the center of a circle, we have in the early stages, an infiltration of cancer cells into the surrounding clefts and spaces. These proliferating cells penetrate the smaller lymph vessels of the deep fascia and continue to grow along these channels both with and against the direction of the current. As the cells grow in the lumen of the vessel, it becomes distended and a reactive inflammation is set up with subsequent destruction of the contained malignant cells. But in the distal portion of the vessel, the cells continue to proliferate. Some of these cells may enter the tributary radicles from either the skin or underlying muscle, and reaching the very thin walled capillary lymphatics, rupture them and establish a metastatic nodule. Then they may continue their growth along the distal lymph channels and ultimately grow into a trunk lymphatic. The force of the current breaks off a group of cells which in turn are carried to a node where they begin to proliferate. Extension from one node to another or from one group to another group comprising the chain, occurs most probably by growth or by embolism through the efferent vessels.

LYMPHATIC PLEXUSES

The entire body is invested with a deep fascial lymphatic plexus that is made up of a vast network of intercommunicating channels. This general plexus may be divided into three main drainage areas on each side of the body, corresponding to the lymphatics draining into (1) the cervical, (2) the axillary or (3) the inguinal lymph nodes. The periphery of each of these areas is composed of very small radicles, intermingling with those belonging to the neighboring lymphatic area, much as do the branches of two trees which grow in close proximity to each other. So-called retrograde growth along the radicles of the breast drainage area may thus involve the cervical or inguinal lymph nodes or the opposite breast.

Although most textbooks describe a subpapillary plexus lying in the superficial layer of the dermis, no one has actually demonstrated a continuous channel running parallel with the skin. It is more probable that the skin lymphatics originate in the dermal papillae as blind sacs, several

joining together to form a vessel, which extends vertically to empty into the fascial plexus. Thus we may visualize the lymphatic system of the breast as a multitude of anastomosing radicles originating in the skin, muscles and breast tissue, joining to form medium sized vessels which are located largely on the deep fascia and ultimately form the drainage trunks which empty into the axillary nodes.

There are three principle groups of vessels which drain the breast: (1) the axillary trunks, which usually consist of two large vessels. These drain the outer anterior segments of the breast; (2) the intramuscular trunks, which drain the outer posterior surface of the mammary gland. These vessels penetrate the pectoral fascia and muscle and empty into the subclavicular nodes. The intramuscular trunks are often absent, and (3) the intercostal trunks, which drain the inner portion of the breast, penetrate the pectoralis major and intercostal muscles and ultimately terminate in the substernal nodes. These latter vessels have a marked tendency to atrophy at the time of the menopause. This fact probably accounts for the infrequency of substernal metastases in cancer of the breast in older women.

VISCERAL DISSEMINATION

Although visceral dissemination is usually looked upon as an expression of embolic metastases by the blood stream, I think that the facts discussed in relation to blood metastases earlier in this paper, should lead us to consider some more acceptable explanation of this phenomenon.

In breast cancer, the most frequent sites of visceral metastases are the pleura, lungs, liver and peritoneum. According to Handley, visceral metastases in carcinoma of the breast arise mainly from the extension of cancerous permeation along the numerous fine anastomoses which, piercing the parietes, connect the lymphatic plexuses of the deep fascia with the subendothelial lymphatic plexuses of the pleura and peritoneum and thus with the mediastinal and portal lymph nodes.

Involvement of the subserous plexuses is soon followed by growth upon the serous membranes. In this manner the adjacent organs become affected and there may be a diffuse distribution of malignant cells in the serous cavities.

Extension to the abdomen usually occurs at the epigastric triangle which is situated only about an inch from the mammary circumference. Here the deep fascia is separated from the subserous fat of the peritoneum by a single layer of fibrous tissue, traversed by lymphatics. The liver, which is the abdominal organ earliest and most frequently affected, is reached by the way of the falciform ligament.

DISTRIBUTION OF METASTASES

We have already considered the question of extension in the immediate vicinity of the breast. We will now take up the extension to other parts.

The locations where we may expect to find secondary deposits are as follows: lymph nodes, pleura and lungs, mediastinum, liver, bones, the opposite breast and axilla.

Lymph Nodes. The location of the groups of lymph nodes that may become involved can be considered advantageously from the standpoint of time and we will therefore, divide them into two main groups, (1) those that become involved early in the course of the disease, and (2) those that become involved in the later stages. To the first group belong naturally those nodes which receive efferent vessels directly from the breast and are the (1) axillary, (2) subclavicular, and (3) substernal. Of these the axillary nodes are the most important for they constitute the filters through which the major portion of the lymph drainage of the breast passes. The pectoral group which lies along the lower border of the pectoralis minor, on the inner wall of the thorax between the pectoral and the serratus magnus muscles are the nodes which are first invaded, but as these are connected to the deeper axillary nodes, the entire axillary group may become involved by extension.

Direct extension to the subclavicular nodes by the way of the intramuscular lymphatics does not occur so often because these trunks are present in only about 50 per cent of cases. However, as there is no

way to determine clinically whether or not they are present, it is always wise to presuppose that they are and plan the treatment accordingly. Occasionally there are found one or two nodes lying between the pectoral muscles in the course of the intramuscular lymphatic vessels.

The substernal nodes form a chain on each side of the sternum and are situated behind the costal cartilages of the true ribs. The vessels from the breast which empty into these nodes usually atrophy at the time of the menopause. Therefore, this group is more important in younger women.

In planning our treatment in comparatively early cases, we should consider not only a direct attack upon the primary lesion and its immediate zone of infiltrating cells, but also the importance of the outer zone of vessels filled with solid cords of proliferating cells and finally the three groups of lymph nodes which we have just discussed.

To the second group belong those nodes which do not drain the mammary gland directly but which become involved either from an adjacent group or through permeation by way of the smaller lymphatic vessels. When nodes of the second group become involved usually there is little or no hope for recovery. We will simply mention those here which may become involved through permeation, to emphasize the necessity of recognizing the avenues of approach to these nodes in order that their involvement may be obviated. They are the supraclavicular, the opposite axillary, the portal, the mediastinal and the inguinal.

Pleura, Lungs, and Mediastinum. These may be considered together for they are all involved in the same manner. The parietal pleura becomes invaded by way of the intercostal lymphatics through permeation. Proliferating cancer cells soon rupture the thin walled subserous lymphatic vessels and the serosa becomes involved. Often this occurs as a polypoid growth and the dissemination of cells into the pleural cavity takes place. At other times the visceral pleura becomes invaded and subsequently the lung. The lymphatics at the periphery of the lung drain into the peribronchial nodes and thus by permeation these nodes ultimately become involved.

Liver. The liver is the most common site of abdominal metastases in carcinoma of the breast. Because the mechanism of dissemination is practically the same for all the organs in the abdomen, a discussion of the involvement of this gland will suffice for all. The process takes place in the following manner. Involvement by permeation of the parietal lymphatics which lie in the lower thoracic region comes first, then direct extension to the epigastric triangle follows. Here the cells penetrate the thin abdominal wall through the communicating subserous lymphatics. From this point the liver may become involved in one of two ways: (1) free cancer cells from the peritoneum may implant themselves on the surface of the liver and thus give rise to secondary deposits, or (2) the permeation may follow the lymphatics of the falciform ligament, thus involving the portal lymph nodes with secondary invasion of the liver. It is important to prevent this sequence of events if possible, by dealing with the area that lies between the epigastric triangle and the breast tissue.

Bone Metastases. The frequency of bone involvement in carcinoma of the breast depends to a great extent upon the length of time the primary lesion has existed. It may vary according to statistics reported by Carman[12] which give 3.48 per cent, up to those reported by Kauffman[13] which are as high as 53 per cent. Carman based his statistics upon surgical cases at the Mayo Clinic which were recognized by roentgen examination. Those reported by Kauffman were based upon autopsy material. Giles[14] collected statistics upon skeletal metastases from which he concluded that well established cases of breast cancer would show an average of 30 per cent bone involvement.

It is probable that the bones most commonly become invaded by permeation of the fascial lymphatics, for those most frequently affected lie within the area which is usually the site of metastatic skin nodules. The point of invasion nearly always corresponds to the area where the bone comes nearest to the surface. Invasion occurs through the periosteal lymphatics. The bones most commonly affected in order of frequency vary according to differ-

ent authors. Handley gives the following: sternum, ribs, femur, humerus and spine, while Carman gives pelvis, femur, spine, ribs, clavicle and sternum.

The rare occurrence of metastatic involvement of the brain, of the eye and of similar structures must be accepted as a manifestation of dissemination in breast carcinoma via the blood stream which is probably brought about by the invasion of a pulmonary vein by cancerous cells which have proliferated in a nearby lymph channel or lymph node.

Opposite Breast. The subsequent appearance of a malignant focus in the opposite breast is always open to the suspicion that we may be dealing with a primary lesion rather than a metastatic one. The fact that cancer may affect both breasts simultaneously and also that the opposite axilla may become affected without an involvement of the corresponding breast gives support to this view. However, in about 10 to 12 per cent of cases which are of long standing, there occurs involvement of the opposite breast. Handley believes that this takes place through retrograde permeation of the fascial lymphatic vessels of the primarily affected breast. In a few advanced cases I have been able to palpate cords of cells extending across the sternum and below the opposite breast with involvement of the opposite axilla. Personally, I believe that the occurrence of malignancy in the second breast is, in the majority of cases, a primary lesion and should be treated as such.

I cannot conclude this paper without calling attention to the danger of manipulating a breast which is the seat of cancer. If it be true that the smaller lymph vessels surrounding the tumor are filled with malignant cells, it is conceivable that even the gentlest handling of this organ may force some of them into the larger channels and thus establish embolic metastases. I believe that much of the lack of success in the treatment of cancer of the breast can be ascribed to the established imperceptible metastases that have been brought about by excessive manipulation of the tumor and its surroundings. This manipulation begins when the patient first discovers the lump. She frequently feels it and often asks her husband or intimate friends to do so. Finally the family physician is consulted and in his endeavor to make a definite diagnosis he, too, often handles the tumor mass vigorously and thus helps in the dissemination of malignant cells. The surgeon is now called in. Although I believe that today the majority of surgeons realize the necessity of careful manipulation of possibly malignant lesions, still there are a few who continue to palpate suspected lesions too extensively. Cancer which can be definitely diagnosed clinically is usually determined by gentle palpation.

A nodule in the breast of a woman past twenty-four demands immediate attention and should always be considered suspicious.

That manipulation increases the incidence of metastases is amply proven by a series of experiments which we are now carrying on. In one of our strains of spontaneous breast cancer mice the normal occurrence of metastases at autopsy is 44 per cent. By manipulation we have raised this incidence to 73 per cent.

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CARCINOMA OF THE BREAST*

RESULTS OF TREATMENT 1918–1919–1920

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IN an effort to standardize the reporting of end-results of operations and other treatment for the cure of cancer, and to secure a uniform method for recording and classifying cases, a committee was appointed in 1922 by the American College of Surgeons; forms were prepared and the coöperation of many of the established hospitals of the country was secured, in order that the study of the material thus collected might yield more reliable conclusions than have been available up to the present time. It is a group of cases, collected and analyzed for this investigation that I shall present, with the understanding that the numbers are too small to permit definite conclusions, but in the hope that the results may be suggestive.

In the years 1918, 1919 and 1920, 175 cases of carcinoma of the breast entered the wards of the Massachusetts General Hospital. This series was reported in November, 1924,[1] but could then be carried only to a three-year end-result. Time has now elapsed sufficient to carry them to a minimum of five years and it is interesting to note that only one of the cases then reported as alive and well, has developed recurrence, while on the other hand, 2 cases then recorded as untraced have since been found to have passed the five-year limit without recurrence. The end-results are therefore practically the same in both reports.

I wish to emphasize the fact that it is with the results of surgical treatment, with and without prophylactic roentgen-ray treatment, that we are here concerned. I have no data to present in regard to the treatment of recurrent or inoperable cases by roentgen rays alone. I can say, however, that we believe the roentgen treatment of such cases to be of the greatest benefit to the patient, both in prolonging life, and in diminishing or entirely relieving distressing symptoms. In fact the success of roentgen-ray treatment in such cases has made it possible to modify materially the selection of cases for radical operation, and with beneficial results to all concerned.

During the period 1918–1920, roentgen radiation was beginning to be used as a routine before and after operation, as a prophylactic measure. About one-half the cases of radical operation in this series had roentgen treatment either before or after operation, or both. The use of roentgen rays rested to a great extent upon the discretion of the individual surgeon. Some used roentgen radiation as a routine, while others called upon the roentgen department for assistance, especially in those cases which they regarded as having the least probability of cure by radical surgery alone.

The treatments were given with a Snook machine under the direction of Dr. George W. Holmes. The factors were: 8 or 16 inch distance, 20 cm. field, 8 inch spark gap, 80 kv., 8 ma., for 5 or 25 minutes

[1] Greenough, R. B. Cancer of the breast at the Massachusetts General Hospital, 1918,1919 and 1920. *Southern M. J.*, 1925, xviii, 187–192.

* Read at the Eleventh Annual Meeting, AMERICAN RADIUM SOCIETY, Dallas, Texas, April 19 and 20, 1926.

with an aluminum filter; this giving what was estimated as an erythema dose. Six skin areas were covered, and the post-operative prophylactic cases had the exposures of one series distributed over a period of three to four months.

Radical operation was interpreted to mean the removal of the whole breast, the skin over it, both pectoral muscles, the axillary contents and the deep fascia, from sternum to latissimus and from clavicle to epigastrium. The transverse axillary incision was most frequently employed and any skin defects were closed by secondary skin graft.

TABLE I

A. Total entries carcinoma of breast	175
B. Re-entries (more than once)	7
C. Recurrent from previous operation	15
c′ Private ward cases, no record	17
c″ Not carcinoma	2
D. Cases available for mortality and operability	134
E. Radical operation (1A-1B-1C = 94; 1D-1E-1F = 6)	100
F. Palliative (incomplete) operation	24
G. No operation	10
H. Operative deaths	4
I. Operative mortality, per cent	3
J. Operability—radical operations, per cent	75
K. Operability—all operations, per cent	91
L. Inconclusive—lack pathological exam	0
M. Inconclusive—untraced	23
N. Inconclusive—died within 5 years without recurrence	4
Deduct these 27 (M + N) from D.	
O. Available for end-result data	107
P. Radical operations (1A-1B-1C cases)	70
P′. Radical operations (1D-1E-1F cases)	6
Q. Palliative (incomplete) operations	21
R. No operation	10
S. Alive and well	21
T. Died without recurrence	0
U. 5-year cures—all operations	21
V. 5-year cures—radical op. all cases	21
V′. 5-year cures—class 1A-1B-1C	21
X. Percentage 5-year cures—all radical operations	27
X′. Percentage 5-year cures—radical operations, class 1A-1B-1C	30

The first matter of interest is the five-year results. Of the 134 primary cases which entered the hospital, 21 are known to be alive and well, five years or more after operation, or 16 per cent. Many of these cases, however, were so far advanced that no attempt at cure could be considered justifiable. In 10 cases no operation at all was done; in 24 cases only an incomplete operation was performed as a palliative measure, and in 6 cases radical operation was attempted in patients obviously too far advanced for cure, as indicated by the presence of disease beyond the limits of the field of operation (classes 1D-1E-1F). Four patients died shortly after operation and are classed as operative fatalities, one of heart disease, one of shock, and two of postoperative pneumonia, an operative mortality of 3 per cent. Four patients died of other diseases between three and five years after operation, without recurrence; and 23 cases cannot be traced to the five-year limit.

We are thus left with 76 radical operations on which we know the five-year end-results; 70 of these were in cases which showed no evidence of disease beyond the limits of operative removal (1A-1B-1C), while 6 were advanced cases (1D-1E-1F); 21 cases are known to be alive and well, five or more years after operation and all of these were in the favorable (1A-1B-1C) group. No cures resulted from radical operation in advanced cases (6); from palliative operations with or without roentgen radiation (21); or from roentgen treatment of cases recurrent after operation done before this period (15). It would appear, therefore, that all hope of cure, in this series, at least, depended upon the possibility of a radical operation being performed in a case that was not too far advanced.

The next matter of interest is the question whether the roentgen radiation used, as it *was* used at this hospital, during this period, was of any benefit to the patient as an adjunct to operative treatment. Seventy-six cases were available for this study in the 1924 report (three-year minimum) and the figures were rather striking.

TABLE II*

RADICAL OPERATION WITH OR WITHOUT ROENTGEN IRRADIATION

Primary Operable Cases

Early: No glands involved ..... 24 cases
Late: Glands positive ..... 52 cases

	Early	Late
A. Rad. op. alone	7/13 = 54%	5/22 = 23%
B. Rad. with pre- and post-prophylactic radiation	2/3 = 66	1/5 = 20
C. Rad. with pre-operative radiation	1/2 = 50	2/3 = 66
D. Rad. with post prophylactic radiation	3/6 = 50	4/22 = 18
B-C-D together	6/11 = 54	7/30 = 23

* Three-year results.

The cases are arranged in two groups, early and late cases, and it is a curious fact that in both groups the percentage of cure with and without roentgen irradiation is exactly the same. The numbers are undoubtedly too small to justify very reliable deductions but we can say, at least, that the chance of radical cure was not increased by the use of roentgen radiation as it was then employed. This is not, however, a very surprising result; for prophylactic roentgen treatment is given, not so much in expectation of increasing the chance of radical cure, as in the hope that if the operation fails, the remaining cancer cells and the surrounding connective tissues may be so affected by the roentgen rays that the cancer tissue may fail to develop for a longer or shorter time.

It was hoped, therefore, that the benefit of prophylactic roentgen therapy might be shown in the recurrent cases, as retarding the onset or the progress of recurrence. This, however, was not the case.

TABLE III*

RADICAL OPERATION WITH AND WITHOUT ROENTGEN RADIATION: AVERAGE DURATION OF LIFE IN RECURRENT CASES

Operation Alone			
21 cases	Aver. 32 months	Early 47	Late 25
Op. + Roentgen-ray			
29 cases	Aver. 21 months	Early 12	Late 23

* Three-year results.

The 21 recurrent cases, after operation alone, lived an average of thirty-two months, while the 29 cases in which roentgen radiation was used in addition to operation, lived only twenty-one months.

The modern radical operation succeeds in its purpose of removing all of the disease in the operative field in a larger percentage of cases than is ordinarily recognized. This is shown by freedom from local recurrence.

TABLE IV*

RADICAL OPERATION WITH AND WITHOUT ROENTGEN RADIATION

	Cases	A. & W.	No. Local		Free from Local, Per Cent.
Operation alone....	33	12	11	23/33	70
Operation + roentgen ray.....	41	12	8	29/41	49

* Three-year results.

The chart fails to indicate that any advantage as regards local recurrence results from the use of the roentgen ray.

If the advantages of pre-operative and postoperative roentgen irradiation cannot be clearly demonstrated, it is our duty to consider their possible disadvantages before subjecting patients to this expensive and time-consuming treatment. To the disadvantage of postoperative treatment there is little to be said. In this series there were no untoward events to be charged against it; but, in the past year 2 patients have come to my attention who had been operated upon and given roentgen treatment elsewhere. Both had passed the five-year limit without recurrence, but one had a squamous cell carcinoma of the skin of the operative field and the other such advanced chronic roentgen dermatitis and keratosis that removal of the entire affected skin had to be advised. Undoubtedly these patients had been given an overdose of soft radiation, but it is not improbable that this harvest is only just now coming to maturity and that the next few years will show more cases of this nature. We must admit then that even postoperative prophylactic irradiation has dangers as well as inconvenience and expense.

So far as pre-operative irradiation is concerned, very definite disadvantages in wound healing are recorded by many surgeons.

TABLE V

PRE-OPERATIVE ROENTGEN IRRADIATION: WOUND HEALING

Radical Operation	Cases	Defective	Per Cent
Series I, 1920			
Without roentgen ray.....	40	8	20
With roentgen ray.....	13	8	66
Series II, 1922			
Without roentgen ray.....	39	7	18
With roentgen ray.....	20	10	50

In Table V two different series of cases are recorded and the figures speak for themselves. Unless a positive advantage to the patient can be shown, I believe pre-operative roentgen irradiation should be abandoned in cases with reasonable prospect of cure by radical operation.

The facts above cited seem to me to indicate that in the radical cure of carcinoma of the breast, roentgen radiation

has not proved of such value as an adjuvant to surgery as was sincerely hoped by surgeons and by radiologists. What then can be done to increase the percentage of cures of this disease? We may consider several factors: (1) duration; (2) extent of disease; (3) extent of operation, and (4) the pathological features of the tumor.

Duration. One of the most widely accepted views in regard to cancer is that the case of long duration, the "late case" is the unfavorable one. So far as the individual is concerned, this is undoubtedly true, but when numbers of cases are studied, different results are obtained. In other words, other factors than months or years are of greater significance.

TABLE VI*

DURATION OF DISEASE

Average Duration, 7.5 Months

	Per Cent
39 cases *above* average—10 "cures"	26
52 cases *below* average—12 "cures"	23

* Three-year results.

The percentage of cures in the cases of a duration greater than the average of the whole number (7½ months) was greater than that of those of shorter duration. We must believe, therefore, that a slow-growing tumor of long duration may have a better prognosis than a more rapidly growing one which has been promptly recognized and treated.

The significance of duration in the individual case is, of course, connected with the opportunity given for wide extension of the disease. Our best criterion by which to judge extent is the involvement of the axillary nodes. In this series 62 per cent of the 16 cases in which the axillary nodes were *not* involved, obtained a five-year "cure," while only 26 per cent of the 50 cases with axillary involvement (but with no evidence of wider extension) were alive and well at the end of the five-year period. These figures are approximately those of other surgical reports and the involvement of the axilla is probably the best measure we have of the extent of the disease, in the average case. It is not infallible, however, as will appear later.

Extent of Operation. Operations which fall short of the limits described in an earlier paragraph as the standard radical operation, have been designated as incomplete or palliative. There were no five-year "cures" from these incomplete operations, whereas 66 radical operations gave five-year "cures" in 35 per cent. In a few isolated cases in the past, cancer of the breast has undoubtedly been cured by incomplete operation, but such a result is not to be expected and the exceptions only go to prove the rule that it is upon the complete radical operation that we must base our hope of cure.

Finally we come to a consideration of the *varying degrees of malignancy* of the disease. I believe it is this feature which accounts for many of the disappointments that we meet in the treatment of breast cancer, as well as for some of our unexpected successes. The work of Broders, MacCarty, Martzloff, Simmons and Daland, and others, has shown beyond reasonable doubt that in squamous cell carcinoma of the skin, the lip, the tongue, and the cervix, different degrees of malignancy can be determined by microscopic examination of the tissue of the tumor. I have attempted to apply these principles to cancer of the breast. In this case, however, we are dealing with a gland epithelium, and typical differentiation is, of course, in the direction of the formation of a gland lumen (adenocarcinoma) and the production of droplets of secretion in the cell. Loss of differentiation and increasing malignancy are indicated by loss of this glandular architecture and absence of secretory activity. With increasing malignancy, we see also variation in the size of cells and of nuclei, increase of mitotic figures and hyperchromatism. Such is a very brief description of the factors which enter into this attempt at estimating the malignancy of cancer of the breast. A more detailed description was published in the *Journal of Cancer Research*.[1] I would emphasize, however, that these facts are by no means new. In every pathological laboratory casual estimates of the degree of malignancy of different tumors are often made. The idea of loss of differentiation of the cancer cell was expressed by Hansemann by the term

[1] Greenough, R. B. Varying degrees of malignancy in cancer of the breast. *J. Cancer Research*, 1925, ix, 453–463.

"anaplasia" and its relation to prognosis has been discussed by him and by many other pathologists at considerable length. It was not often, however, that these characteristics of the tumor were reported to the surgeon. So far as I know no practical application of the facts was made and no large group of clinical results were checked against these pathological degrees of malignancy, until Broders' work in 1920.

The slides of this series of cases were examined by Dr. J. Homer Wright, Dr. C. C. Simmons, and myself. This was done without knowledge of the clinical histories of the cases. Three groups were distinguished: (1) low, (2) medium, and (3) high malignancy; these facts were then entered on the clinical record and the cases tabulated.

TABLE VII

	Cases	Cures	Per Cent
CLASS 1—LOW MALIGNANCY			
19 Cases—13 Cures, 68 Per Cent			
A. Group (glands not involved)	11	9	82
C. Group (glands involved)	8	4	50
CLASS 2—MEDIUM MALIGNANCY			
33 Cases—11 Cures, 33 Per Cent			
A. Group (glands not involved)	7	3	43
C. Group (glands involved)	26	8	31
CLASS 3—HIGH MALIGNANCY			
21 Cases—0 Cures, 0 Per Cent			
A. Group (glands not involved)	5	0	
C. Group (glands involved)	16	0	

The figures speak for themselves, but two points should be emphasized: (1) it appears that cases of low malignancy even with axillary involvement give a better prospect of cure than the less extensive cases in the group of medium malignancy, and (2) no case of high malignancy, even though clinically of so favorable a character that the axillary nodes were not involved, resulted in a cure.

We must give consideration to these facts in studying our results in the treatment of cancer of the breast, and they explain a number of things which have hitherto been hard to understand.

Making due allowance for the fact that this is a small series of cases, we believe that the following conclusions are justified:

(1) Radical operation performed before the disease has extended widely offers the best expectation of cures for cancer of the breast.

(2) Pre-operative and postoperative irradiation with roentgen rays, as given at the Massachusetts General Hospital in 1918–1920, does not appear to have been of value as an adjunct to surgical operation.

(3) Nearly 30 per cent of all cases of cancer of the breast are of so malignant a character that with our present resources we are unable to cure the disease.

(4) The remaining 70 per cent of cases give reasonable hope of cure by operation when the disease is not too far advanced.

(5) Education of the public and of the medical profession as well, to a better appreciation of the possible significance of all breast tumors, and to a more prompt application of treatment, may yet notably diminish the mortality of this disease.

(6) In the treatment of breast cancer, which is beyond hope of cure by operation, roentgen irradiation offers prospect of relief which can be obtained at present by no other means.

THE REACTION OF THE PLEURA AND LUNGS TO ROENTGEN RAYS*

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GROOVER, Christie and Merritt, in 1922, were the first to call the attention of the profession to the fact that exposure of the thorax to roentgen rays may, under certain conditions, be followed by pleural and pulmonary reactions. Since then many other radiologists have submitted confirmatory evidence. It is unfortunate that most writers on the subject should have misleadingly called this pleuropulmonary reaction "pulmonary fibrosis," because this term describes only the final phase of the reaction. Indeed, in many cases the degree of intensity of the reaction is never sufficient to lead to permanent fibrotic changes. In some of the cases that have been reported the abnormalities observed clinically and roentgenologically became gradually less prominent or disappeared completely. Hence, in such cases at least, one is hardly justified in speaking or writing of the change as pulmonary fibrosis, because a lesion that once reaches the stage of true fibrosis does not thus disappear, but leaves a scar as permanent evidence. The term "fibrosis" should be reserved to describe only those cases in which the alterations in the tissues are permanent.

An inflammatory reaction of pleura and lungs to irradiation may occur in any case in which a sufficient dose of radium or roentgen rays has been directed to those structures. That roentgen rays are more commonly responsible for the phenomenon is because, in dealing with thoracic diseases, such as cancer of the breast, or with intrathoracic tumors, such as lymphosarcoma or Hodgkin's disease, roentgen rays are employed much more extensively than radium. Were the latter used over equally large thoracic surfaces, still more pronounced changes might follow.

SYMPTOMS OF PLEUROPNEUMONITIS

The symptoms of pleuropneumonitis generally appear from two to four weeks after a course of roentgen-ray treatment, and consist chiefly of cough, shortness of breath, and sometimes fever. The cough, irritative and nonproductive in character, is frequently paroxysmal and quite distressing. Often it begins suddenly and the patient thinks she has "caught cold." The dyspnea, varying with the degree of the pulmonary irritation and with the activities of the patient, may be slight or quite pronounced. If there is fever, it usually subsides within a week or two; many patients never have fever. Intrathoracic pain is an occasional complaint, but is seldom sufficiently severe to be considered an outstanding feature. Weakness is usually proportionate to the degree of dyspnea and cardiac embarrassment. Hemoptysis is quite rare. A definite increase in the pulse rate is common, and, as it comes on rather suddenly with the onset of the other symptoms, is often noticed by the patient. A burning sensation in the chest is an infrequent manifestation.

The acute phase of the symptoms subsides in from one to three weeks, but cough and dyspnea may persist in some degree for weeks or months. In many cases the symptoms disappear completely in a short time, but if the patient is submitted to further roentgenization they may return later in a more severe form; under such conditions the cough, dyspnea, weakness and increased pulse rate may continue indefinitely, the pulse rate and weakness diminishing slowly as the remaining lung tissue adapts itself to its new functional requirements, and as more or less of the injured pulmonary parenchyma recovers its normal activity.

Except during the acute stage of the process, the general condition of the patient is not greatly influenced as a rule, but his activities frequently have to be curtailed on account of dyspnea.

* Read at the Eleventh Annual Meeting of the AMERICAN RADIUM SOCIETY, Dallas, Texas, April 19 and 20, 1926.

PHYSICAL SIGNS

The physical signs vary considerably, depending on the degree, extent, and situation of the pleural or pulmonary tissue injured. These signs are generally limited to one side; in the case of cancer of the breast, to the side of the amputation, whereas in other diseases they are confined to the side receiving the strongest dose. During the acute stage, dry and moist râles in all degrees of pitch and volume can be heard over the affected lung. A distinct pleural rub is sometimes audible. Evidence of pulmonary infiltration may be elicited, this naturally depending on the depth and degree of the infiltration. Pleural effusion is known to occur with the more severe grades of irritative inflammation; in the majority of cases it is not sufficient to be recognized clinically or roentgenologically.

As the acute manifestations recede, the râles, as well as the other auscultatory and percussion signs, may disappear completely, and no evidence of abnormality remain; or the physical signs may diminish to a large extent and evidence of chronic pleuritis persist in the form of adhesive bands or more or less extensive symphysis of the pleural layers. Obliteration of the costophrenic angle and interference with the diaphragmatic excursion on the side of the lesion are common sequelæ. If sufficient pulmonary tissue has been involved, a varying degree of functional impairment results, leading to compensatory emphysema of the remaining pulmonary parenchyma.

ROENTGENOLOGIC SIGNS

During the early phases the roentgenologic signs may consist merely of the diffuse fog of inflammatory pleural thickening, with or without the still denser shadow of effusion, or they may simulate fairly closely those of the focal type of pneumonia so commonly seen after influenza. This may begin at, or near, the hilus, or the area of infiltration may be well within the lung fields. The infiltrated zone may quickly reach its maximal extent and density, and then progressively clear up, or the process may be more gradual and extension continue over a longer period, in which case the changes are more likely to leave permanent marks. Since the site of such infiltration must necessarily depend on the conditions of the roentgen-ray treatment, the possibility that the roentgen rays may be responsible for the pleuropulmonary process must include the coincidence of cause and effect in the same region. The zone of infiltration is generally irregular in outline and density; indeed it may have some of the earmarks of an abscess; however, there can hardly be any confusion from the point of view of symptoms and clinical signs. If the infiltration is central and sufficiently extensive to interfere with the free passage of air toward the periphery of the lung, the lobe or lobes so hampered in their function collapse more or less. Whether or not partial or complete expansion will occur subsequently must depend on the degree of permanent pulmonary impairment and functional interference. Gradually the infiltration shadow becomes less dense; according as the injury has been slight or severe, the clearing process may or may not proceed to complete organic and functional restoration. If restoration is only partial, there is evidence of more or less distinct pleural thickening and adhesion to the parietes or the diaphragm on the affected side. This limits respiratory excursion and efficiency. The infiltration may entirely disappear if the irritation has been relatively slight, but the cases which have stimulated interest in the problem are precisely those in which a variable degree of permanent alteration in the density of the lung tissue remained as evidence of the injury. Such alteration usually consists of irregularly arranged strands of varying density, producing a distinct change in the architecture of the lung field and disturbance of the normal markings. In some cases the final picture gives the distinct impression of scar formation, while in others this impression is more or less blurred by the superimposed pleuritis which may be limited to the basal, peripheral, or interlobar portions. Deviation of the mediastinal structures toward the affected side, and fixation and elevation of the corresponding leaf of the diaphragm are often observed.

DIFFERENTIAL DIAGNOSIS

The foregoing description represents the clinical and roentgenologic manifestations in typical cases. There are other cases, however, in which such manifestations may be confusing; so much so, indeed, that he would frequently be rash who, from a single examination, would venture to make a definite diagnosis between, for instance, the pleuropneumonitis following roentgenization and certain forms of pulmonary metastasis. Often one must keep the patient under periodic observation and make several roentgenographic examinations before one can feel reasonably certain of one's ground. This is all the more important when the roentgenologist makes his interpretations without any knowledge of the clinical aspects of the case. I make it a point to mention this, because a hasty roentgenologic diagnosis may work an injustice to the patient. Inasmuch as the present-day clinician depends to a considerable extent on the roentgen-ray findings in estimating the condition of the patient's intrathoracic structures, it is of the utmost importance that he receive no impression that does not rest on solid ground.

It is well known how difficult of recognition are certain forms of metastasis to the lungs, especially the diffuse variety, in which the lymphatics of the pleura and lungs become filled with viable cancer cells. Inasmuch as the symptoms and physical signs of pulmonary metastasis often simulate those of the pleuropneumonitis following roentgenization, at least during the acute stage, the radiologist must be on his guard lest he also become confused.

Of particular importance in distinguishing between diffuse metastasis and pleuropulmonary reaction to roentgen rays is the fact that in the former the process is generally bilateral, whereas in the latter it is generally unilateral. In the roentgen-ray reaction there is a tendency to retraction of the injured lung and of the mediastinum toward the affected side; one lobe or the entire lung may be partially or completely collapsed, and the symptoms tend to subside, but, even when the cough and dyspnea persist, the patient's general condition remains better than one would expect with malignancy.

The roentgenologic appearance of metastasis varies according to the manner in which the metastasis occurs. In some cases the process manifests itself as scattered foci in one or in both lungs; in others it is diffused more or less uniformly throughout both lungs. The former variety is easily recognized, but the latter requires close and often repeated scrutiny before it can be recognized. The roentgenologic evidence of the diffuse form generally consists of hazy, line-like streaks along the bronchi, radiating from the hilum outward into the parenchyma. It is usually bilateral and more pronounced on the side corresponding to the primary tumor. There may be fine mottling, slightly suggestive of miliary lesions. In many cases the line-like streaks have a distinctly beaded, finely segmented appearance; in others the streaks are less distinct, the fine beading or speckling being distributed irregularly about the field. Although the roentgenologic appearance of diffuse metastasis is often suggestive, it is seldom sufficiently characteristic to warrant a definite diagnosis from a single observation. However, when the roentgenologic findings are supported by strong clinical evidence, a tentative diagnosis, at least, is justifiable.

In certain cases the distinction between the pleuropneumonitis due to roentgenization and lung abscess must be made. Such a distinction is rarely difficult if one bears in mind the clinical features of pulmonary suppuration. The abundant expectoration of pus, and the irregular and rather high fever are sufficient in most cases to remove any possible doubt. Both conditions might possibly coexist, in which event the distinction must be decidedly more difficult.

Pleuropulmonary reaction to roentgen rays may also have to be distinguished from other inflammatory manifestations, but, if the radiologist is careful to inquire into the possible relationship between the manifestations exhibited and any roentgen-ray exposure to which the patient may have been subjected, the distinction will generally not be difficult.

MECHANISM

What are the factors entering into the production of this pleuropulmonitic reaction to roentgen rays? Nearly all writers on the subject have conveyed the impression that this inflammatory condition affecting pleura and lungs, following irradiation of the thorax, in certain cases, is related in some way to the use of roentgen rays of short wave length. As a matter of fact, the wave length of the rays plays but a comparatively small part in the problem. It matters little whether the rays are generated at 140 peak kilovolts or at 200 peak kilovolts, or, within certain limits, how much filtration is employed. These elements probably exert a certain limited influence on the process, but the chief factor is quantitative, and relates to the dose as it is affected by the duration of exposure. By this I mean that inflammatory manifestations in pleura and lungs are the more likely to supervene the nearer the dosage approaches, or passes beyond, the limit of normal skin tolerance. In other words, if the dose is such as to produce a marked skin reaction, the pleura and lungs also are likely to be irritated. I have observed such manifestations when the roentgen rays were generated at 200 peak kilovolts, and I have seen similar reactions when the rays were generated at 135 peak kilovolts.

That the foregoing is particularly true in the postoperative treatment of carcinoma of the breast is not surprising, because the thickness of the tissues of the chest wall remaining after the complete amputation of a breast is not sufficient to make much difference between the dose received by the skin and that reaching the pleura and lungs. Thus pleuropulmonary changes are almost always found on the side of the amputated breast, even when both sides of the thorax have been equally treated. Exceptions are occasionally encountered in undernourished women with very small breasts and unduly thin thoracic walls. Similar reaction has been observed in patients being treated for lesions other than carcinoma of the breast, but only when the chest wall was unusually thin or when the dose of roentgen rays was exceptionally strong. According to my experience, pleuropulmonary reaction never follows the first course of roentgen-ray treatment and seldom the second, but on further treatment given with full dosage, manifestations are probable. During a period of more than two years, in the treatment, not only of carcinoma of the breast after radical amputation, but also of many other thoracic or intrathoracic diseases, I commonly made use of the following dose: voltage, 135 peak kilovolts; distance, 40 cm.; filtration, 6 mm. aluminum; milliamperes, 5; time, forty-five minutes. This produces well-defined erythema in nearly all patients, and in a few it causes what is generally described as a skin reaction of the second degree. Under this regimen I observed at least 20 cases in which the question of pleuropulmonary changes conceivably related to the roentgen-ray treatment had to be envisaged. In a number of these cases the condition of the pleura and lungs was found later to be due to metastatic invasion. But in at least an equal number, the clinical and roentgenologic alterations could not be explained on any basis other than that of irritation by roentgen rays. After analyzing the situation closely, I decided to continue to use the same technical factors in similar cases, but to reduce the time of exposure by five or ten minutes, according to the degree of natural pigmentation of the patient's skin. This change was made more than a year ago, and since then I have not seen a single instance of pleuropulmonary reaction.

Those who are interested in photography know the relationship between the size of the camera diaphragm, the length of exposure and the degree of latitude in development. The larger the aperture of the diaphragm, the greater the intensity of light projected against the plate or film, the shorter the exposure required and the less latitude one has in development. Conversely, the smaller the opening of the diaphragm, the longer must be the exposure, but the latitude in development is increased in proportion. Photographers are constantly making use of this optical principle. In radiotherapy filtration plays a somewhat similar rôle; that is to say, the less the filtration employed, other things remaining equal, the shorter the duration

of safe exposure and the less the latitude between the time necessary to produce slight erythema of the skin and that required to produce serious injury. Conversely, the greater the degree of filtration employed, the greater the latitude between an exposure that will produce a faint erythema and one that will cause ulceration. Whether or not such variation in latitude is proportional to the degree of filtration has not been determined, but that a relationship exists between latitude and filtration is beyond doubt.

This involves the question of the influence of wave length on tissue reaction. That such an influence exists can hardly be questioned, but, in my opinion, the part it plays in the problem under consideration is far less important than the quantitative factor represented by the duration of exposure.

DISCUSSION ON PAPERS OF DRS. SIMPSON, GREENOUGH, AND DESJARDINS

DR. JOSEPH C. BLOODGOOD, Baltimore. Before the advent of roentgen rays and radium I had a very large experience with the operative treatment of cancer of the breast, and am very familiar with the elements of error which may creep in, so that even today it is a very difficult thing to compare the results in the different clinics throughout the world. The same element of error will be present when we try to ascertain what pre-operative and postoperative irradiation have added to the cures after complete operation.

I believe it is very important for me again to call attention to this element of error. In 1918 in making a very critical statistical study of the five-year results in all cases of cancer of the breast in relation to the various factors, nothing came out right. I knew there were 300 border-line cases diagnosed cancer. In the group *cancer of the breast without metastasis to the axilla*, with these border-line cases included, the five-year cures were 85 per cent; with these cases out, the figures fell to 70 per cent. There is every reason to believe that this border-line group is included in perhaps all of the reports in the literature.

In the first place, these patients never die of cancer of the breast. Studied by a good pathologist, there is never metastasis to the glands. The patients remain well and without recurrence, whether the operation is removal of the tumor, the breast, or a complete removal. Here are the records which seem to show that it was not dangerous to remove a breast tumor without thermal or chemical cauterization, close the wound and then—some days or weeks later—when the pathologist has decided that it was suspicious of malignancy or early cancer, or adenocarcinoma, or malignant adenoma, or chronic cystic mastitis with microscopic areas of cancer, or distinctly malignant, but nevertheless not fully developed scirrhous or medullary carcinoma—then, after this diagnosis, to perform the complete operation. It is never dangerous, after removing a benign tumor, to do more. When the sections of this border-line group are submitted to a number of good pathologists, there is always a difference of opinion as to malignancy, but there is never any difference as to the result. As this group has marred all statistical studies of cancer of the breast after the complete operation, and has always increased the percentage of five-year cures from 5 to 20, we may expect the same in the statistical studies when radiation is based upon the same pathological error. This group undoubtedly explains those cancers of the breast which have remained well after removal of the tumor followed by irradiation. There are one or more unpublished cases in every clinic. They really should be submitted to a committee of pathologists according to the Codman bone registry plan.

In the surgical pathological laboratory of the Johns Hopkins Hospital we have been fortunate in being able to record and to restudy all the cases of cancer of the breast not by rereading the old pathological reports, but by reexamining the sections or making new sections. The percentage of five-year cures, after the complete Halsted operation for cancer of the breast with metastasis to the glands, has varied very little from our first real investigation in 1900 up to date. If no glands are involved and the border-line group is not included, 70 per cent are living at the end of five years. When the base glands of the axilla show metastasis there is a drop from 70 to 25 per cent. When the mid- and apex glands are involved this percentage falls to 10.

Just bear these figures in mind. Realize the importance of the pathological diagnosis and the bookkeeping. If the border-line group is included, there is at once a possibility of an error of 15 per cent. If there is any mistake in the record of the involvement of glands, the difference between "glands not involved" and "glands involved" is as 85 is to 20 with the border-line group included, and as 70 to 20 with it excluded.

The majority of the clinics in this country and in Europe confess in their published reports

to a great element of error in the records of the pathological examination of glands, and in practically no clinic outside of Johns Hopkins has there been a uniform, continuous and detailed study and record of the actual extent of the involvement of the axillary glands.

This element of error has made it very difficult to estimate the real percentage of five-year cures after the complete operation for cancer.

I have recently finished a careful review of all the cases of cancer of the breast of which I have a record, which have been subjected to irradiation in addition to the complete operation, and I am unable to find any positive proof of any great value in irradiation. So much so, that I have decided not to subject cases of cancer of the breast to irradiation which, before operation, are clinically early or doubtful cases and which, after operation, show metastasis to the mid glands only. I have given this group sufficient trial. I will continue to give radiation to every other case in which the apex glands are involved, knowing that this group has but 10 per cent chances of a five-year cure, in the hope that by comparing the results in the two series, I may be able to detect the value of radiation.

When a cancer of the breast shows beginning cancer *en cuirasse* or skin metastasis, or edema of the areola, I know that surgery has as yet never accomplished a cure whether the axillary glands were involved or not. Therefore, these cases have been, in the past five years, subjected to radiation first and then to the complete operation; some of them to radiation only. In this group, if there has been an operation, the chest wall dissection has been made with the electric cautery or the diathermy knife. More than fifteen years ago I used the cautery for the axillary dissection, and recently I have tried diathermy, but have given up both and returned to my alcohol-sponge technique which I have been using in the axillary dissection for fifteen years. As yet I have no proof that operation with the cautery or diathermy, or the alcohol-sponge technique has increased the percentage of five-year cures. I am interested in ascertaining what method of treatment is best for the patient. The greatest discomfort after complete operation for cancer of the breast is lymphedema of the arm. My studies seem to show that this is due to faulty surgery or very late intervention.

When cancer of the breast is in the late stage, with a large local growth, and the complete operation of a type that gives the best assurance against local recurrence and lymphedema of the arm is essential, then only the most expert surgery can compete with radiation as a palliative measure. One must have very large experience to do these tremendous local operations with the skin grafting, but when these operations are well done, the patient dies of internal cancer without external recurrence.

My studies, therefore, up to the present time, seem to show that the cautery, the diathermy, the alcohol-sponge technique and radiation have not increased the five-year cures of properly performed complete operations. At the present time the hope of increasing the number of these cures rests upon the ample evidence that the shorter the duration of the lump, the less the likelihood of axillary metastasis, and the greater the probability of a cure. There is no doubt that for many years many surgeons and radiologists will continue to use radiation in this group with the hope of improving the number of cures.

No radiologist will deny that skin metastases have appeared after complete operation notwithstanding irradiation. Also, that metastases have disappeared. The disappearance of skin metastases, or any external palpable area under irradiation is no indication of a cure. The lessening of the mediastinal shadow, the ossification of an area of bone destruction is no indication of a cure.

Radiation as a palliative treatment when there is distinct recurrence after operation, when the local growth has passed the stage for operation, when there are signs of metastases to the skeleton, when there is external ulceration and internal pain, today offers more than operation. My own conclusions from my experience up to date are: The complete operation for all operable cancers of the breast, whether or not the roentgen examination shows metastasis to bone or mediastinum, continues to be the method of choice. If there is no evidence of metastasis, this offers the only chance of a cure. If there is evidence of metastasis to the chest or skeleton, the operation is best for the local growth. When there is evident metastasis, irradiation should always follow in these cases, and if metastasis is to the vertebrae, irradiation should precede operation. When the chest wall growth has passed the stage of operability, irradiation offers more than operation.

The most satisfactory evidence of the value of irradiation is the relief of pain associated with metastasis to the vertebrae. Even here areas of destruction have ossified, and patients after two or more attacks of pain have been temporarily relieved. The best results follow irradiation of the spine. Irradiation offers nothing for metastasis to the liver. In fact, irradiation of a metastatic tumor in the liver only adds to the discomfort of the patient.

As I wish to emphasize here the importance of the complete operation in suitable cases, so do I also wish to emphasize radiation as the chief therapeutic agent in palliative treatment.

It is my rule now to take a roentgenogram not only of the chest, but also of the pelvis, as bone metastasis often precedes any evidence of mediastinal metastasis.

Many of my colleagues, both among surgeons and roentgenologists may not agree with me, but they do not realize that I may be seeing a different group, because, due to the long period of intensive education, the type of cancer of the breast in my clinic has changed. Inoperable cases have been reduced from 55 per cent previous to 1900 to less than 5 per cent since 1920. In over 50 per cent of cases of cancer of the breast the glands have not been involved. Practically all of my cases have had a thorough roentgen-ray study before operation, and the tissues after all operations have not only been studied, but saved. The follow-up of the breast cases has been complete. The patients given pre- and postoperative irradiation have been under the care of my colleague, Dr. Kahn, at the office, and perhaps the majority have been treated elsewhere throughout this country. So that my patients have had the benefit of every type of technique and of the most efficient roentgen-ray apparatus in the United States. I believe that I have given radiation a thorough and complete trial. As a curative agent in cancer of the breast it has failed. As a palliative agent it is the best we have today. Surgery at the present time can offer for cancer of the breast without metastasis to the axilla only 70 per cent cures, and I can find no evidence that continuous postoperative irradiation adds anything to the results in this group.

DR. EMIL G. BECK, Chicago. I think we need not worry over the operative mortality in cancer of the breast. It is negligible. The frequency of recurrence is the distressing factor. I have adopted certain principles as guides in the treatment, depending upon the stage of the disease and the condition of the patient. These principles are: (1) We regard the cosmetic result as of secondary importance, and the complete elimination of the disease of the first importance. (2) We employ a radical measure which gives more prospect for complete recovery even at the risk of greater mortality in preference to a less radical operation which can be only a temporary relief, means greater suffering within a short time, and finally a miserable death. (3) It is of the greatest importance and advantage to combine surgery and radiotherapy. Neither of these alone can produce the best results. (4) We classify our cases in four groups, and in each the treatment is definitely outlined.

In the *first* group we include cases of localized carcinoma, confined entirely to the breast proper, with no involvement of the axilla or any other part of the body. In those cases we remove the breast only, and do not expose the axillary space to the implantation of cancer cells, a "conservative method."

In the *second* group are included the cases in which the axillary glands are involved, but not the supraclavicular. In these cases we resort to the most radical resection of the breast and the axillary glands, but *we do not close the wound.* We leave it widely open for subsequent radium and roentgen therapy.

In the *third* group belong the cases in which the axillary as well as the supraclavicular glands are already involved. In these cases the operation cannot be too radical. We have in 8 cases of this type resorted to the resection of the shoulder girdle, and I am pleased to say that we have saved 3 out of the 8, two of them living for more than ten years. Unfortunately, many patients would not submit to such a radical procedure; they would rather die than live without an arm, but had they known of the suffering that awaited them they would no doubt have reconciled themselves to this radical procedure. If they will not permit this radical operation, then it is best not to operate at all but to try radiotherapy alone, for an incomplete operation in such a case only prolongs the suffering.

In the *fourth* group are classed the recurrent cases. In these we too often find metastases in the lung and other parts of the body, and nothing but a palliative measure is of any value. If there are no metastases, and the disease is confined to the shoulder alone, the shoulder resection is indicated.

I will not speak of the operative procedures in these various groups as that belongs to the domain of surgery, but my associate, Dr. Orndoff, who will present this discussion, can speak authentically on the pre- and postoperative treatment, as he has treated many of these cases.

There still exists a difference of opinion as to the value of radiotherapy in the treatment of cancer of the breast because of the large percentage of recurrence in the present day as compared with the preradiotherapy period.

I have reached the conclusion that the results of radiotherapy would be far more useful if radiologists would work more in harmony, and associate with surgeons in order that the surgeons may prepare the field for the radiotherapy, and thereby facilitate the postoperative treatment. It is difficult to deliver into

the seat of the disease a sufficient quantity of radiation to kill every cancer cell without serious injury to the normal cell. Over-irradiation will make normal cells more susceptible to the invasion of the cancer cell. The toxemia resulting from over-irradiation is also responsible for a good many failures for the reason that a larger dosage had to be employed than would have been necessary had the field of operation been open instead of closed.

Dr. Henry Schmitz, Chicago. The results of microscopic examinations of tumors are of the utmost interest to the clinician. They tell about the type and the malignancy of carcinoma. Therefore Dr. Simpson's paper is of great importance to the members of the Society.

Dr. Greenough raised two important questions: The advisability of combining radical operation of the breast in apparently operable carcinomas with irradiation, and the study of the histological malignancy of the carcinoma to see if thereby some of the unexpected results of treatment could be explained. For years we have compared the histological studies with the result of treatment in cancer of the cervix after a physical examination. We have divided the breast cases into groups. In the first group the single, movable growths are placed; in the second, the multiple but movable growths; in the third, the growths with regional gland involvement, and in the fourth group the inoperable cases characterized by invasion and fixation to neighboring tissues and organs. In the first group we recommend amputation. In the second group, multiple movable growths or a history of perceptible increase in size, we precede the radical operation with roentgenotherapy and radium. In the third group roentgenotherapy, radium and operation are used; and in the fourth roentgen rays and radium are used to ameliorate the suffering of the patient.

In the recurrences we distinguish four groups: (*a*) local, (*b*) regional, (*c*) fixation of local or regional recurrences, and (*d*) extensive infiltration. The first three groups are subjected to radium and roentgen rays, if they had not been used at the first operation, and excision if the recurrent tumors are movable. Otherwise only palliative treatment is employed. I can report only on the three-year results obtained with our methods. They are as follows:

Primary: Group 1. Seven cases; living 5 or 71.5 per cent.

Primary: Group 2. Twelve cases; living 6 or 50 per cent.

Primary: Group 3. Fifteen cases; living 2 or 13.3 per cent.

Primary: Group 4. Fourteen cases: none living.

Recurrent: Group 1. Eleven cases: living 7 or 63.5 per cent.

Recurrent: Group 2. Fourteen cases: living 5 or 35.7 per cent.

Recurrent: Group 3. Thirty-one cases: living 2 or 6.5 per cent.

Recurrent: Group 4. Twenty-six cases: none living.

Roentgenotherapy is very often used in absolutely hopeless cases, but with the hope of amelioration of the ravages of the disease. One patient came to us in December, 1924, who had had a radical operation on the breast one and a half years before. She had been in bed for two months and was in pain all the time. Roentgen examination of the skeleton revealed involvement of the greater number of the vertebrae and the innominate bone as well as the humerus. Roentgen rays were applied to all the affected bones. Blood transfusion was given to overcome the leucopenia, to which she responded immediately. Within four or five weeks she was absolutely free of pain and spent the winter in Florida. In August, 1925, she returned complaining of pain in the neck. A roentgenogram of that particular part then showed an invasion of the cervical spine. The neck was now irradiated with a combination of radium and roentgen rays. The roentgen rays were applied from either side and radium packs at a distance of 3 cm. over the rear part of the neck. Within three or four weeks she again felt completely relieved. The movements of the head were normal and painless.

Several similar cases with similar results could be cited. Such cases demonstrate the possibilities of palliation that can be attained with irradiation. Perhaps it is in the field of palliative therapy of carcinoma where irradiation attains better results than other treatment.

Dr. Henry J. Ullmann, Santa Barbara, Calif. We had a report some time ago from the Memorial Hospital in New York as to the value of pre- and post-radiation in cancer of the breast. Now we have this report from Dr. Greenough, which is of vast importance not only because of the work they are doing, but because it is so different from the other reports. I wish to ask a few questions in the hope that this difference may be explained. It may give us some information that will enable us to advise our surgeon friends and our patients as to whether we should in any given case give pre- and post-radiation: (1) Is there a difference in the operative technique in the two groups? (2) In the group that received irradiation were the radiation techniques comparable? (3) and part of the second question, it is possible in any group of statistics in

which radiation was used to know whether the recurrence is higher than in the non-irradiated group? In these cases was the radiation given to a degree sufficient to lower the resistance of that individual to cancer? We know this may occur and that it may bring on metastases sooner.

I am very anxious to have Dr. Greenough's opinion on these matters.

Dr. Curtis F. Burnam, Baltimore. We are deeply indebted to Drs. Simpson and Greenough. It is a dangerous thing to lay down fixed rules as to treatment. They are no sooner fixed than found to be inapplicable to all cases. Dr. Greenough has reported a series of cases that were treated in a definite way. We should remember, however, that roentgen and radium radiation are still rather new. It is the generally held opinion that for breast irradiation a wave length corresponding to 100,000 peak voltage is the most desirable. It is understandable that in direct irradiation of the chest walls, as in Dr. Desjardins' report, it is better to use soft radiation of this kind in order to protect the lungs; in the axilla and neck it seems much more logical to apply as penetrating radiation as possible to produce the greatest depth effects in proportion to the superficial as is possible.

Drs. Bloodgood and Greenough are correct in their statements that in spite of the patients who are helped by operation and the present methods of treatment, there are a large number who are not benefited. I see a number of breast cancer cases after operation and find many of them with recurrences on the chest wall, in the skin, or in the local regional glands. It is posssible when metastasis has occurred in the skin, or in the axilla and neck glands, under favorable conditions to secure disappearance with proper irradiation. When we keep in mind the fact that a number of these inoperable conditions are curable by radiation, we should not abandon postoperative irradiation unless the evidence is overwhelmingly against it by statistical studies such as presented by Dr. Greenough.

Dr. Douglas Quick, New York City. It seems to me that Dr. Burnam has gotten very clearly at the situation from the standpoint of the radiation treatment of these cases. Dr. Burnam suggested using softer radiation for the chest wall, varying the radiation in conformity with the part to be reached. There are other considerations; for instance, Finzi's idea of irradiating the chest wall at a tangent so that less damage will be done within. We must give more attention to the wave lengths. I am not convinced that the effect of more heavily filtered roentgen rays and the harder gamma rays of radium is the same. In fact, I question it. It has been suggested that the shorter rays of radium have more effect on cellular tissues, whereas roentgen rays have more effect on the connective tissue elements.

One thing that little has been said about in this symposium is the use of radium itself. I grant that surgery and roentgenotherapy cover most of the field in cancer of the breast, but I think in certain phases radium plays a large part. In certain of the local tumors where it seems advisable to use the physical agents, where intense radiation can be gotten in by buried radium, I think this is distinctly preferable. I think this is particularly true in the axilla. I have in a number of instances felt that burying filtered radium emanation under the pectoral, or, in an occasional setting, burying it directly in the axillary content where it could not be cleaned out carefully, had a distinct advantage over trying to use too much radiation from the outside. I know one surgeon who has a small amount of radium which he uses in his own work. He says he does not know much about the physical factors involved, but in his own work he knows it does a certain thing under certain conditions. He looks upon it as a valuable surgical instrument.

I am much encouraged by this discussion this morning. It suggests to me that we are getting somewhere with the whole problem. Dr. Greenough has shown us how they are classifying their cases, both clinically and histologically. We have heard something of Dr. Broders' efforts along the same line in their work. I am sure Dr. Greenough will credit the Massachusetts General Hospital with much better radiation today than in 1918, 1919 and 1920. We are getting better results. There are a certain few patients who will refuse to have any surgery, and I think they are legitimate cases in which to push physical agents to the limit. There are some patients who will not submit to as much surgery as the surgeon would like to use, and there the physical agents can be used to see how far they will carry them over. I must disagree with Dr. Bloodgood, and more especially with Dr. Beck, about doing any surgery on the case that is outside the strictly operable group, the one with the metastases elsewhere. I think all-in-all at the end of the year a good deal more is accomplished for these patients by leaving them entirely in the hands of radium or roentgen rays than by doing any surgery.

In that connection also I think there is a good deal of fallacy in something that is spoken of frequently by roentgenologists, and that is that the inoperable case become operable following a round or two or heavy radiation. I feel very strongly that if a case is once inoperable it

is always inoperable; that some change which makes it look mechanically operable does not make it actually operable.

Dr. Simpson (closing). In the 6 cases with no involvement of the lymph nodes that Dr. Greenough reports as dead, did they die of local recurrence or of cancer elsewhere? If they did not die of recurrence, as I suspect, they must have had cancer somewhere else, or in other words, metastases. They did not die of the high malignancy, but because they had metastases.

The question of radiation, to my mind, depends upon whether radiation has a specific action on the cancer cell or not. If not, it is not better than surgery. We are working now with radiation empirically. The fact that radium or roentgen rays will cause a tumor to melt away and disappear is proof that we have a physical agent that potentially has the power to destroy tumor cells. I have seen cases in which I know the cancer cell did not get a cauterizing dose, and yet the growth has disappeared. What are the subtle biological changes that take place? Our problem today is to determine the mechanism of the action of the rays on the cancer cell.

I have found upon microscopic examination of tumors removed some time after irradiation that the surface cells apparently were little affected, as evidenced by deep staining and the presence of mitosis, although 2 or 3 cm. below, the cells were all necrotic. Is it not probable that in our attempt to reach the deep-seated cells we pass by the superficial ones and thus leave a focus of virulent cells? It seems that careful measurements and a proper application of filters would obviate this undesirable condition.

Dr. Greenough (closing). As Dr. Simpson intimates, the results reported by Dr. Bloodgood and by me fail to indicate any material benefit from prophylactic irradiation in surgical cases. I regret very much that this is so, but after all it is our duty to find out the facts and to plan our treatment accordingly. A number of points present themselves for consideration. In the first place, I would like to emphasize the fact that the classification of the degree of malignancy of a tumor is, of course, only one factor in the problem. The extent of disease is, of course, of equal or greater importance. I have, perhaps, laid more emphasis on the degree of malignancy in the attempt to bring it to your consideration. Dr. Simpson asked for the details in the 6 favorable cases which failed to obtain a five-year cure. One was an operative fatality, dying of pneumonia immediately after operation. Four were cases of high grade malignancy and the sixth case was one with a tumor in the upper-inner quadrant in which supraclavicular nodes appeared shortly after operation, although the axillary nodes were microscopically free from disease. This was apparently a case of direct extension above the clavicle.

The figures I have presented are not in accord with those of Dr. Lee at the Memorial Hospital. The explanation for this I cannot give, but I am struck with the fact that Dr. Lee presented two groups of cases: (1) those which were treated without prophylactic roentgen irradiation by a number of different surgeons in New York, and presumably by several different methods of technique. These he contrasts with (2) a group of cases given pre-operative and postoperative roentgen irradiation at the Memorial and operated upon by Dr. Lee himself. I wish we might have a report of a series of cases with and without roentgen irradiation but all selected and operated upon by the same technique. During the years 1918–19–20 roentgen radiation was given in much smaller doses and with a very different technique than that employed today. It is possible that the results of roentgen radiation as it is used at the present time will show an improvement, but we shall have to wait at least five years in order to judge of this.

When it comes to the advanced cases, choice between radiation and operative treatment is a difficult one. I am inclined to side with Dr. Quick and to disagree with Dr. Bloodgood. I believe these cases do better, live longer and with less discomfort when radiation is employed without operative interference. I am certain this is true when there is extensive disease in the axilla.

In connection with the spread of the disease in the superficial lymphatics of the chest, I will say that there are 2 cases in this series both now seven years after the primary operation, in which the remaining breast subsequently developed disease. In one case the second tumor was of exactly the same histology as the first and I regarded it as an extension. In the second case, however, the tumor of the second breast was of an entirely different character and of a lower degree of malignancy. I feel sure in this case that the tumor in the second breast developed *de novo*.

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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EDITORIALS

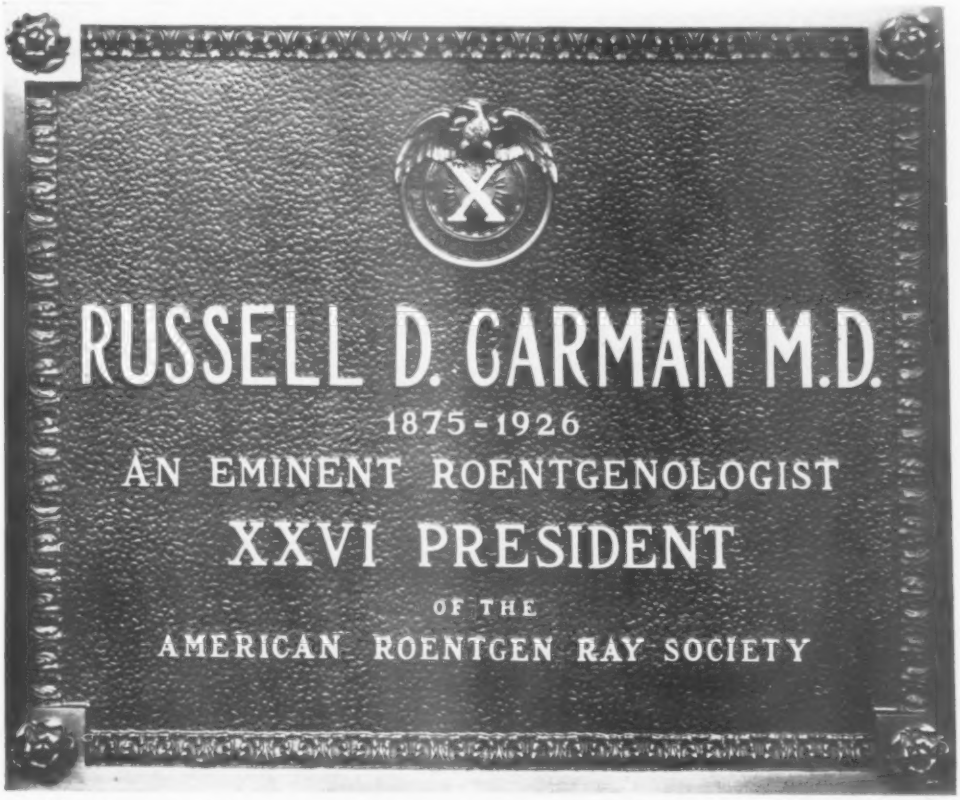
PRESENTATION OF A MEMORIAL TABLET TO RUSSELL D. CARMAN BY THE AMERICAN ROENTGEN RAY SOCIETY

THE American Roentgen Ray Society presented to the Mayo Clinic a bronze tablet in commemoration of Russell D. Carman, on the evening of September 29, 1926. Dr. Alexander B. Moore presided at the meeting and introduced the representatives of the American Roentgen Ray Society who presented the tablet, and the speakers from the Mayo Clinic and the Mayo Foundation who made responses.

The exercises were held in the lobby of the Clinic before a large audience. Mrs. Carman was present. Visitors from a distance were Drs. Carl Beck, E. S. Blaine and B. H. Orndoff of Chicago; A. P. Overgaard and James F. Kelly of Omaha, and Thomas A. Burcham of Des Moines.

Dr. Skinner, at the conclusion of his remarks, unveiled the tablet which is of bronze, 14 × 17 inches in size, bears the insignia of the Society in relief, and the following inscription also in relief:

Russell D. Carman, M.D. 1875–1926
An Eminent Roentgenologist
XXVI President of the
American Roentgen Ray Society



Memorial tablet to Dr. Carman presented to the Mayo Clinic by the American Roentgen Ray Society.

The following addresses were delivered.

Dr. A. W. Crane, Kalamazoo, Michigan

ONETIME PRESIDENT OF THE AMERICAN ROENTGEN RAY SOCIETY

We are here in testimony of our grief at the loss of a friend and to express appreciation of the most eminent roentgenologist of his time.

This tablet is offered in thankfulness that Carman was not unappreciated while he lived. His reputation penetrated to every part of the world where the x-ray is used. His laboratory was a Mecca. No other roentgenologist was visited by so many of his contemporaries of every land or had won a larger measure of affectionate regard. He was one prophet who was not without honor in his own country. His unanimous selection as president, one after the other in rapid succession, of the two great national x-ray societies is, we believe, without a parallel. This meant more than a recognition of his professional achievements; it was a tribute to those qualities which in the aggregate constitute manhood and purpose in work.

It is these human and moral qualities that distinguish Carman as they have distinguished many another great man. We have no intention of cataloging Carman's virtues, but a few outstanding characteristics must impress any one who recalls his discussions at medical meetings or who has studied his writings understandingly. A love of truth was fundamental, with never a special pleading for any view. His fairness towards the work of others often amounted to a fine courtesy. His modesty, so becoming to a man of science, was innate but did not prevent a singular strength of assertion. His sincerity and his conscience demanded that every written statement have ample grounds and be expressed unequivocally.

These are some of the reasons why he stood as an undisputed authority throughout the world. But there are, of course, other reasons. Of the intellectual side of his work he proved to be a master. His early selection as the head of a department of this great clinic is an apt example of the faultless Mayo judgment of men. It is to the glory of this clinic that department heads are given free rein. Carman's development was his own. His power of organization proved ever equal to the increasing dimensions of his work—the increasing clinical demands and the increasing scope of roentgenology.

It has been said in explanation of Carman's unexampled achievements that he had unexampled opportunities, an unexampled wealth of material, and unexampled surgical checking of roentgen observations. This is true. But it sets the seal of real greatness on the man who could so successfully cope with tasks so intricate and so large. It required unremitting industry and untiring mental vigor to animate the force of which he was always a working member and to give out day after day correct x-ray diagnoses for the never-ending stream of patients that flows into the wards of the Mayo Clinic. It required no less an unblunted keenness of vision to turn out year after year papers on the minutiae of roentgen diagnostics and to make discriminating analyses of case-groups numbering in the thousands. And finally it required no ordinary power of correlation to reduce this mass of original material to order and meaning in a book which will preserve his memory as long as the x-ray is used for the alleviation of human suffering.

Carman was at the height of his powers when compelled to retire by that most dreaded enemy of living cells. With unequalled experience, with complete mastery of unrivalled clinical material, with matured literary power, he was more than ever ready to put into permanent and available form the accumulating roentgenologic findings of the clinic to which he had given full measure of devotion. We cannot exaggerate a loss so great, neither can we fully understand it until time has set its own valuation.

Carman's courage in his last days was an inspiration. What other quality of character commands such universal admiration? There was something inexpressibly tragic in the circumstances of his death. Few indeed are the patients who know while yet vigorous that their days are numbered. The roentgen ray was like a mighty genie

that he had made his absolute servant and that he could evoke at will. Without warning it turned upon him at the apex of his career and revealed with remorseless clearness the brevity of his days and the manner of his end.

The news that Carman was stricken spread with that mouth to mouth rapidity that outstrips the telegraph and there came back a great wave of sympathy which we hope somehow softened the end.

Medicine and surgery are enriched by the history and traditions of their great men. What practitioner but feels an uplift of the spirit and a pride of professional kinship when he thinks of his illustrious predecessors. For many years roentgenology had none of this but gradually, inevitably, this background of our professional life is forming. America has contributed her share of great names and now Carman takes his place with Leonard, Caldwell and the other immortals. What Osler is to medicine, what the Mayos will sometime be to surgery, that Carman is to roentgenology.

DR. PRESTON M. HICKEY, ANN ARBOR, MICH.

ONETIME PRESIDENT OF THE AMERICAN ROENTGEN RAY SOCIETY

On an occasion like this when we are gathered together, both to honor the memory of a dear friend, and at the same time to dedicate a tablet as a memorial to a distinguished writer and investigator in the field of roentgenology, we find it difficult to express our feelings adequately, as our grief at our own loss is mingled with admiration and appreciation of the eminent roentgenologist. First of all, in order to fill in a background for this ceremony, it is fitting to preface a few words about the American Roentgen Ray Society which is presenting this tablet in behalf of its own members and in behalf of all American roentgenologists. This Society has had many worthy members actuated by a love of scientific truth and characterized by a willingness to undergo personal sacrifices. When Dr. Charles Lester Leonard who made the first x-ray plates of a kidney stone in America, after months of suffering passed over the great divide, the members of this Society authorized the Leonard Prize awarded at stated intervals for original research in this special field. When Dr. Eugene Caldwell, one of the first in America to write a volume on x-ray technic and the interpretation of x-ray plates, found at last a relief from his sufferings, the members of this Society instituted the annual Caldwell Lecture which is always an important event in each year's progress in roentgenology. The individuals of this Society, I can truly say, are more to each other than simply co-members of the organization, they are warm personal friends who embrace the opportunity at their stated meetings to cement more firmly the bonds of friendship. Truly, while other organizations oftentimes divide our time and attention, the ties of love and esteem are especially conspicuous among our various members. Furthermore, I think it is quite true that most of the followers of this specialty feel a sense of brotherhood which is much more conspicuous than in some of the other and older branches of medical knowledge. Perhaps this is due to the fact that many of the pioneer workers were martyrs, losing their lives through their devotion to their chosen specialty. There now is, therefore, on the part of the members of the American Roentgen Ray Society a feeling of poignant grief at the loss of their friend, which is as deep seated and genuine as their admiring appreciation of the scientific attainments of Russell D. Carman.

It is not so many years ago that Professor Roentgen, with the accurate observation of a trained scientist, reported the discovery which has revolutionized our concepts of matter and which has led to new and marvelous methods of diagnosis in surgery and medicine. In the new world of roentgenology which soon followed, there were many pioneers who, by their zeal and indomitable perseverance, blazed the trails of progress, which, in the course of time, became highways for those who followed. To change the simile, the beacon lights of progress at first were indeed few and feeble and the charts of navigation were exceedingly meagre, and often treacherous. As time went on, Williams, Can-

non, Hulst, Cole and many others led the way in the special applications of the x-ray in gastrointestinal diagnosis. The surgeons and the internists were beginning to ask if the x-ray could not be used as a diagnostic aid in cases where patients presented indecisive symptoms of abdominal pathology. The speaker remembers a lecture given in the first decade of this century by Dr. Christopher Graham formerly of this clinic, on the differential diagnosis of ulcer, gall-bladder disease and appendicitis. The great clinician set forth the important symptoms of these different conditions, but nevertheless made clear the difficulties of a differential diagnosis based on the symptoms alone. Later Dr. Russell D. Carman was called to this great clinic and began the study which resulted in observations which have been so helpful to us all. He found at his disposal a great wealth of clinical material and unequalled opportunities for the study of living pathology as demonstrated by the surgeon. This permitted of the correlation of his own x-ray studies and began soon to lay the foundations for his monumental work. In his book, when it appeared, he showed that he utilized to the full extent the opportunities which surrounded him. Undoubtedly he fully realized that his work needed to present decisive findings in order to furnish to others a reliable diagnostic manual and guide. Unless one pauses very carefully to consider what a tremendous gap in x-ray knowledge this book filled, one will not fully realize its importance. It has been the speaker's opportunity to watch the educational development of many of the younger workers in the field of roentgenology in their x-ray studies of gastric diagnosis. To them, the work of Carman and Miller is, as it were, a veritable Bible, the dicta of which are unquestioned because the conclusions presented are deduced from a vast experience in x-ray, clinical, operative and pathologic studies. It must have been a source of great satisfaction to our departed friend to realize, as indeed he must have, the great aid which his work afforded to so many students, to so many men whose ambition is great for the performance of accurate work, but whose individual personal opportunities are often comparatively limited.

One of the privileges of membership in the great x-ray societies is the opportunity to listen to the spoken words of the masters in the various branches. No one contributed more to the success of the programs of these societies than did Russell Carman and no speaker on any of the programs had a more attentive audience or one more appreciative of the important facts presented. After the stated meeting, he was always the center of a group discussing with them the subject in which they were most interested, and frequently helping them to find the solutions of the difficulties which they were encountering.

He always took a great interest in the meetings of the x-ray societies to which he belonged, and he was very determined to plan a successful annual meeting when called to the presidency of the American Roentgen Ray Society. His solicitude for the meeting was a distraction for him during his illness. We all know how successful his efforts were in planning the brilliant program last Spring, but perhaps we do not all realize how keen was his disappointment at not being able to be present in person. I quote the following from a personal letter immediately after the meeting: "My inability to attend the meeting was a disappointment from which I shall never fully recover and my only solace was in knowing that it was successful."

Spiritualism is a belief which is very attractive to many, even to some noted doctors, because of the comfort derived from the alleged messages from departed friends. However, how much more attractive it is to take down from our library shelves the books and monographs which contain the authentic messages of a great authority like Carman. On rereading his written pages we can feel that we are again in the intimate presence of that earnest worker, knowing that we are receiving messages with decisive conclusions at which he arrived, touching the important problems of diagnosis.

On our shelves are always to be found the volumes of Gray, Ziegler, Osler and those

written by the great masters of surgical diagnosis, that constitute the foundation of our medicine and surgery. On the shelf of our roentgen library, where are placed the volumes and monographs on the digestive tract, we will always find the writings of Carman, classed as the first authoritative work in English on the roentgen diagnosis of the digestive tract. However many may be the volumes added as the years roll by with their increased burden of new facts and startling discoveries, the authors of the future will always have to acknowledge that the foundations of their work were builded by the one whom we are commemorating this evening.

While we have been most appreciative of the value of Carman's work, we feel that it would not be complete to close without accentuating a beautiful trait of his character, namely, his innate modesty. As he climbed the ladder of fame, he never lost that charming side of his character—that simple modesty which was so conspicuous.

Amid the dreaded scenes of the great War, every now and then occurred those beautiful ceremonies where the medals for distinguished service were presented and the many citations for bravery were read. These ceremonies were usually short and were always most impressive but the full realization of their meaning came only when one had the ability to visualize for what the decorations really stood. They were only the commemorative symbols which helped preserve the memory of some unselfish deed or some service of momentous value. In this gathering this evening, for the purpose of the dedication of this memorial tablet, with its simple inscription, the ceremony becomes more impressive as we realize what the tablet really commemorates. This is an affectionate tribute from the friends of Russell Carman. We must indeed remember that the greatest tablet to him whose memory we revere was erected by Carman himself; by his forceful work he has cast a memorial tablet all his own which is enshrined in the minds of the followers of roentgenology in all parts of the world where medical science is cultivated.

DR. E. H. SKINNER, KANSAS CITY, MISSOURI

CHAIRMAN OF EXECUTIVE COUNCIL, AMERICAN ROENTGEN RAY SOCIETY

Genius is a quality of many great men. Geniality is the possession of but few. Genius usually exhibits itself in the work of one who may shun the walks frequented by the many. Geniality requires the comradeship of friends, associates and acquaintances for its full development. How rare is the combination of genius and geniality.

But we are gathered here this evening to seal into the memory of time an acknowledgment of the genius and geniality of one who has been a dear friend to many of us while he has been a large figure in the development of a science which benefits all mankind.

We could easily record the genius of Russell Carman in the detail of his works throughout the years. It may be more difficult to establish the perpetuation of the record of that wonderful geniality which he displayed in his work and his associations. Therefore I would dedicate my remarks to Russell's geniality. The mere fact that one uses his Christian name is a simple but sturdy testimony to this quality of friendliness and comradeship that has always characterized the man whom we honor tonight. Scientific medicine will pay sufficient tribute in the years to come to the everlasting virtues of Carman's superabilities in radiology and in medicine. It remains for those of us who knew him intimately to establish and maintain a knowledge of those virtues which are unusual in genius.

The character of the tribute of the American Roentgen Ray Society to Carman's memory this evening is an acknowledgment of their gratitude for Carman's contributions to radiologic diagnosis. This society has been established for twenty-six years. Yet never before, even in the passing of many illustrious radiologists, has the Society expressed itself so promptly and so fittingly. True it is that Carman was the President of this pioneer organization at the time of his passing. But this coincidence was not the origin of the impulse to pay some sort of permanent tribute to the

memory of Carman. Twenty-five eminent radiologists have been honored by being elected president and have in turn honored this old society.

It must be apparent to all of us that there was some unusual quality that was the possession of Carman which has prompted this speedy and dignified tribute. Genius alone does not stir the heart. Genius is without sentiment. Genius does not prompt us to a display of sympathy and sentiment and love. But combine with genius those marvelous qualities of friendliness, cheerfulness and kindliness and human fellowship and you find the springs of regard and honor and love. Genius is mental and cold, and time places the inevitable laurels of deserved praise upon the brow of genius. But it is the qualities of the heart and hand that lead us to the impulsive display of friendly tribute. Genius may stimulate the brain but geniality warms the heart.

And thus it is that while the American Roentgen Ray Society offers homage to the genius of Carman, it is prompted to this immediate tribute through the friendly geniality and sympathetic kindliness in which each of the members has always held Russell Carman.

We offer this tribute to his memory in the rooms which saw him develop into a world figure in radiology and scientific medicine. Upon the very walls which reflected his smile and which echoed his melodious chuckle and which knew his undying charm, the American Roentgen Ray Society places this tribute of everlasting bronze.

Dr. William J. Mayo

Dr. Crane, Dr. Hickey and Dr. Skinner, representing the American Roentgen Ray Society, in the presentation of this beautiful memorial tablet have conferred a great honor not only on the memory of their late President, Dr. Russell D. Carman, but also on the Clinic.

It is a great satisfaction for the staff to know that our late colleague held so high a place in the esteem of this distinguished body of medical men. We appreciate the action of the Society in their recognition of Dr. Carman, and are especially grateful to our guests tonight, who represent the outstanding talent in roentgenology and who have given of their time so freely to meet with us.

To evaluate properly the work of Dr. Carman one must go back and survey the earlier methods of obtaining knowledge in the group of diseases in which the x-ray has proved to be so outstanding a method of determining facts.

We usually measure progress in medicine from the time of Aristotle, who, in the fourth century, B.C., developed deductive logic based on accurate observations by the unaided eye. The sixteenth century was a fruitful period of history, marked by the work of Harvey and Sydenham in medicine, Shakespeare in letters, and Francis Bacon in logic. Bacon developed inductive logic based on experimentation, which marked a new period in scientific investigation. In the sixteenth century, A.D., also the microscope was invented by the Jenssen brothers. The extraordinary effect of the microscope on medicine is apparent when we consider the contributions to science which have been made by its aid.

It is worthy of emphasis that 95 per cent of all knowledge comes either directly or indirectly through the eye. Until the beginning of the present century the microscope was the chief means of obtaining accurate information in medicine. It is true that necropsy had been giving a vast amount of information directly, but on dead tissues. The exploratory incision was a great step in advance, because it exposed living tissues, but as a rule it was made in the late stages of disease, when the symptoms were so pronounced that both the physician and patient could see its necessity, rather than in the early stages in which, in neoplastic disease at least, it gave the great opportunity to cure.

With the coming of roentgenology, vision was extended into fields of matter previously invisible. Roentgenologic diagnosis presents unusual features. The x-ray picture is not a photograph of the object, but of the shadow or silhouette of the object. In the early days of x-ray diagnosis, very beautiful films, from the artistic standpoint, were often obtained, but either they failed to show the significant shadows, or

the evidence of pathologic changes in living tissue, in which both the patient and the physician were interested, was not properly interpreted.

It has been said that by studying the life work of a man one can visualize his soul. One observes that even in his earlier work Carman had an intense desire to learn the truth. Day by day he personally took the x-ray films to the hospital, and stood by the side of the operating table when the exact pathologic condition was exposed, that he might check the x-ray evidence with the operative findings. Through the many years that Dr. Carman worked with us here, he was always deeply interested in obtaining information which might be useful to the patient. While he visualized what the x-ray should produce in diagnosis, he never allowed himself to be carried away by new theories, but based diagnosis on demonstrable facts.

Another side of Dr. Carman's character is worthy of attention and emulation. He combined with his desire to build up a great roentgen-ray department, a vital interest in medical education. Any great achievement is the lengthened shadow of the life of one man. When Carman's life work was done he had left not only a monument in his contributions to science in his chosen specialty, but also, of even greater importance, in the character of the men whom he had trained. His students are now practicing their art here and elsewhere in the manner that Dr. Carman exemplified in the Clinic.

What a remarkable legacy he left us in the associates in the x-ray department, Dr. Moore, whose almost uncanny diagnostic acumen helps us day by day, Dr. Sutherland, Dr. Kirklin, and Dr. Miller. While we have lost the personality that made Carman loved, we have retained the inspiration of his example and the organization which he built that will carry the work along in the years to come as he would have liked to have it carried on.

Of Carman, the man, I will say little at this time. He was a dear friend, a reliable counsellor, a man to whom one could turn for advice on any subject, with the assurance that it would be not only sympathetic but sound.

I can only thank again these gentlemen who have come to Rochester to do honor to their friend and colleague, and assure them of the grateful appreciation of the Clinic.

Dr. C. H. Mayo

I am glad to concur in all that has been said about Carman by the delegates of the American Roentgen Ray Society which he loved so well. The presentation of this memorial tablet by this Society is a fine thing, and is important as an indication of a new tendency in the medical world. In the past it was seldom that societies gave concrete evidence of their appreciation of men of great achievements who had been members. Since the Great War medical men have begun to appreciate themselves and one another. For centuries statues of the famous generals who led their men to death have been erected in the capitals of the world, but no honor was given to the men who were saving lives. There has been a great deal of talk about Pasteur but scarcely any concrete evidence of admiration. During the War it became apparent that medicine could do great things in the prevention and control of disease, and the services that medicine can render humanity constantly become more numerous.

I wish to express my gratitude to this great Society which has honored Dr. Carman, for he surely deserved recognition for his untiring devotion to that branch of medicine in which he spent his life. I welcome this opportunity to express my appreciation of Carman and of the members of the Society that he loved and that appreciated and loved him, and who have taken this means of crystallizing their feelings.

Dr. L. B. Wilson

On the part of the University of Minnesota, through the Mayo Foundation, I wish to thank the American Roentgen Ray Society for this mark of appreciation of one of the members of our faculty. One function of a graduate school is to perpetuate the greatness of its teachers. A graduate school of any worth must have great men on its faculty and their greatness must be handed on to future generations

through the men who study under them. Unfortunately, this was done only to a small degree with Carman, for few men came under his teaching. It is sad that his wonderful life was cut so short, for only part of a generation of roentgenologists have known him, and it is not a man's published work so much as his spirit that counts and the inspiration of a great man's spirit is given mostly to those who work with him intimately.

The presentation of this tablet of bronze by the American Roentgen Ray Society is an excellent thing. The Egyptians built pyramids to commemorate their great men and rulers, the Greeks carved statues, the Romans perpetuated the images of their famous men in paintings, and our Puritan forefathers kept the memory of their dead fresh by carving crude headstones. All of these have been adequate ways of commemorating great citizens, of keeping alive memories that may inspire future generations. This tablet, placed in the building where Carman carried on his great work, will serve as an inspiration to many generations of students, and will keep his memory alive for many years to come, long after we who knew him are gone.

The President of the American Roentgen Ray Society, Dr. P. F. Butler of Boston, who was unable to be present sent the following telegram which was read:

"The Carman memorial tablet is an expression of esteem and affection held by members of the American Roentgen Ray Society for Dr. Russell D. Carman, our former president. He was a true leader of men in his chosen science and in the hearts of all those who knew him. We will do well to emulate his life and his high devotion to the cause of medicine. We mourn his great loss but are thankful to the Creator for having given us this noble character."

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY *visiting New York City, are invited to make the office of* THE JOURNAL (*76 Fifth Avenue, New York*) *their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

THE LAKE MOHONK CONFERENCE ON CANCER

ON September 20–24, 1926, the American Society for the Control of Cancer conducted a most unusual meeting at Lake Mohonk, New York. The large quiet hotel at this beautiful retreat on the edge of the Catskills, operated under the rigid rulings of its charming Quaker owners, made an ideal location for careful, uninterrupted deliberation. The attendance consisted of seventeen distinguished guests from abroad and approximately one hundred invited guests from widely scattered points in the United States and Canada.

On the evening of September 20, an open meeting was called to order by Dr. Howard Canning Taylor, president of the American Society for the Control of Cancer. Dr. George A. Soper, the secretary of the Society, explained the purposes of the meeting and Dr. W. H. Welch extended a welcome to the foreign guests. Sir John Bland-Sutton, president of the Royal College of Surgeons of England, responded for the visitors.

On the morning of September 21, the scientific session opened with Dr. Francis Carter Wood in the chair. Most of the speakers from abroad made short talks in their native tongues after which their papers, which had been translated, were read in English.

Sir John Bland-Sutton spoke on "The Value of Coordinated Effort among Surgeons, Pathologists and Others in the Control of Cancer." He strongly advocated the group method of attack as now employed at the Middlesex Hospital in London.

"Cancer Education in England" was the subject of a paper read by Mr. W. Sampson Handley, who explained that the average Englishman is perfectly willing to take a sporting chance with cancer and is not enthusiastic over giving it publicity as a preventive measure.

Papers were next read by Dr. Henri Hartmann, director of the Anti-Cancer Center at the Hotel Dieu, Paris; Dr. Leon Berard, director of the Anti-Cancer Center at Lyons, and Dr. T. Marie, director of the Anti-Cancer Center at Toulouse. These papers dealt with the organization of the anti-cancer centers in France, each of which is manned with surgeons, internists, radiologists, pathologists and physicists and is usually connected with a university.

Dr. Charles DuBois, president of the Swiss National League for the Control of Cancer, was not present and his paper was read by Dr. Reverdin. The Swiss Radium Institute was described and the statement was made that "oncology" should be a new speciality in medicine.

Dr. J. Maisin, director of the Center against Cancer at Louvain, next read a paper in which he described the four centers in Belgium established by the Royal Cancer Commission. He also detailed some of his experiments with tar cancer in animals.

The last paper of the day, by Dr. Johannes Fibiger of Copenhagen, called attention to the high incidence of cancer in Denmark and pointed out the interesting fact that careful investigation has shown the disease to be fairly common among the Eskimos of Iceland and Greenland.

On the morning of September, 22, the first paper was read by Dr. Raffaele Bastianelli, vice-president of the Italian League for the Control of Cancer. He explained the organization of the League which is attempting to educate the medical profession as well as the public.

Dr. Ferdinand Blumenthal, director of the Cancer Institute of Berlin, then read a paper on "The Organized Cancer Movement in Germany." He said that so much radiation therapy had been done by incompetent workers in Germany that the method had fallen into undeserved disrepute in many quarters.

At this point a paper by Dr. Donald C. Balfour on "Results of Surgical Treatment of Cancer of the Stomach" was read by Dr. Charles Mayo. He stated that every person over thirty-five with digestive symptoms should have a barium meal examination done by a competent radiologist since this method of diagnosing early cancer of the stomach is by far the best one.

Dr. Robert Bierich, director of the Institute of Cancer Research at Hamburg, next read a paper on "The Work of Diagnosing and Treating Cancer in Germany" in which he described a large amount of biochemical investigation.

A paper entitled "Radiological Treatment of Cancer" was then read by Dr. Robert B. Greenough of Boston, who stated that the examination of a large mass of statistics shows that the number of ultimate cures of cancer of the cervix obtained with radiation about equals the number obtained by radical surgery if the surgical mortality be considered. He feels that radiation should be favored because the surgical failures are made worse by surgery, whereas, the radiation cases practically all improve even when the ultimate result is bad. He also described a series of cases of cancer of the breast in which life had been definitely prolonged by radiation.

The next paper, entitled "The Value and Proper Equipment of Institutions for the Treatment of Cancer by Radium and X-Rays," by Dr. Claude Regaud of Paris, was an excellent treatise on the possibilities of radiation therapy. The results obtained in each type of cancer were described. Dr. Regaud stated emphatically that he felt that the promiscuous renting of radium to physicians not trained as radiologists should be considered malpractice.

Dr. George A. Soper of New York read a paper describing the organization and activities of the American Society for the Control of Cancer

The last paper of the day, by Dr. Joseph Colt Bloodgood, was entitled "Evidence of the Value of Education in the Control of Cancer." He called attention to the improvement in the results obtained with bone sarcoma as a result of the Bone Sarcoma Registry and cited as an encouraging circumstance the fact that many people are coming to his clinic with noncancerous lesions which have aroused their suspicions. He advocated periodic examinations and more research.

On the evening of September 22, Dr. James Ewing spoke at an open meeting on "The Prevention of Cancer." He stated that he believes that heredity plays no part in human cancer and the parasitic theory is untenable. He favored chronic irritation as the most important etiological factor and felt that prevention should consist of such things as efficient oral hygiene, removal of pigmented moles, treatment of infected sinuses, moderation in the use of tobacco and alcohol, treatment of cervical lacerations and endocervicitis, measures to decrease the incidence of syphilis, efficient treatment of chronic mastitis including drainage of retained secretions in the ducts and care of diseased nipples and attention to the general health, particularly as regards physical exercise. Ewing also said that he does not believe that earlier diagnosis will greatly improve the present statistics covering the cure of cancer. Mr. Handley remarked in discussing this paper that lymphatic stasis is undoubtedly an important factor in cancer etiology and that the automobile is perhaps a harmful agent since it prevents exercise.

On the morning of September 23, Dr. Gustav Roussy, director of the Institute for Research and the Treatment of Cancer at Villejuif, read a paper in which the many proposed theories of the origin of cancer were critically analyzed.

Dr. J. A. Murray, director of the Imperial Cancer Research Fund of London, next read a paper entitled "The Tissue and Racial Specificities of Cancer."

The next paper by Dr. Archibald Leitch, director of the Cancer Hospital Research Institute in London, described the various types of cancer known to be due to external irritants, such as soot, crude mineral oils, heat, betel nuts, arsenic and certain dyes.

Dr. Francis Carter Wood of New York then described some of his own researches in the Institute for Cancer Research at Columbia University. Experiments were presented showing the danger of producing

metastasis by massage of malignant tumors. However, the careful incision of a tumor for a specimen was shown to be relatively harmless. A recent investigation was detailed which showed that even large therapeutic doses of roentgen rays produced no demonstrable changes in the lymphatics.

Dr. Wm. DeVries, president of the Netherlands Cancer Institute, gave an excellent survey of the prevalence of cancer as shown in a large autopsy material at the University of Amsterdam. He found that 33 per cent of the cancers found at the autopsy table had not been diagnosed clinically. His figures show a steady increase in cancer of the breast and genitalia since 1911 while other varieties have shown little change.

Dr. H. T. Deelman, professor of pathology at the University of Groningen, then presented a paper in which he demonstrated that the mortality from cancer among people of different races shows little variation when statistics are carefully compiled.

The next paper entitled "The Chance of Death from Cancer" was read by Dr. Louis I. Dublin, statistician for the Metropolitan Life Insurance Company. He showed that health activities have changed conditions so that the chance of dying from cancer is now much greater than from tuberculosis, whereas, we are more likely to die from heart disease or nephritis than from either cancer or tuberculosis.

Dr. George H. Semken of New York in his paper entitled "Cancer as a Specialty" insisted that a surgeon who is intending to operate on cancer cases should be so trained that he can locate all metastases and efficiently remove all involved tissue that can be reached with the knife. He deplored the system whereby radium is rented to untrained physicians.

Dr. Harry C. Saltzstein, Detroit, then presented a paper on "The Cooperation of Newspapers" in which he explained the methods used in getting publicity during a very successful cancer propaganda campaign in his city. He said that editors will accept material for publication only when it is news and to be news it must deal either with love or a fight or must contain a suspense element.

The last paper of the symposium, by "Dr. Howard Lilienthal of New York, was entitled "The Relation of the General Practitioner to the Cancer Problem."

Just before adjournment Dr. Francis Carter Wood was asked to discuss the lead treatment of cancer. He said that although some of the clinical results were encouraging the efficient dose was so near the fatal dose that the method could hardly be given to the general profession unless a toxic form of lead could be discovered. He also said that favorable results had not been obtained with squamous cell carcinoma.

At an executive session a statement for the public dealing with known facts about cancer was unanimously adopted. Radiation and surgery were placed on an equal footing as therapeutic agents in this statement.

Dr. Regaud proposed an international organization for the study of cancer with a publication designed to place all articles of the world's literature in the hands of workers in every country. The Congress voted to investigate the practical possibilities of such an organization.

On the night of September 24 a dinner for the delegates to the Congress and their friends was held at the Astor Hotel in New York and on the morning of September 25 the visitors were taken to the New York Cancer Clinic and Hospital by Dr. Isaac Levin and then to the Rockefeller Institute for lunch. After lunch several demonstrations were made by Drs. Carrel, Noguchi and Murphy. Dr. Carrel kindly showed his moving picture of growing living fibroblasts and white blood cells. In the afternoon a program was presented by the staff of the Montefiore Hospital under the direction of Dr. Lenz.

CHARLES L. MARTIN.

STATEMENT OF THE FACTS AND OPINIONS AGREED TO BY THE

INTERNATIONAL MEETING ON CANCER CONTROL

SEPTEMBER 20–24, 1926, HELD AT LAKE MOHONK, N. Y.

Although the present state of knowledge of cancer is not sufficient to permit of the formulation of such procedures for the

suppression of this malady as have been successfully employed for the control of infectious disease, there is enough well-established fact and sound working opinion concerning the prevention, diagnosis and treatment of cancer to save many lives, if this information is carried properly into effect.

1. The causation of cancer is not completely understood, but it may be accepted that for all practical purposes cancer is not to be looked upon as contagious or infectious.

2. Cancer itself is not hereditary, although a certain predisposition or susceptibility to cancer is apparently transmissible though inheritance. This does not signify that, because one's parent or parents or other members of the family have suffered from cancer, cancer will necessarily appear in other persons of the same or succeeding generation.

3. The control of cancer, so far as this subject can be understood at the present time, depends upon the employment of measures of personal hygiene and certain preventive and curative measures, the success of which depends upon the intelligent cooperation of the patient and physician.

4. Persons who have cancer must apply to competent physicians at a sufficiently early stage in the disease, in order to have a fair chance of cure. This applies to all forms of cancer. In some forms early treatment affords the only possibility of cure.

5. Cancer in some parts of the body can be discovered in a very early stage, and if these cases are treated properly the prospect for a permanent cure is good.

6. The cure of cancer depends upon discovering the growth before it has done irreparable injury to a vital part of the body and before it has spread to other parts. Therefore, efforts should be made to improve the methods of diagnosis in these various locations and the treatment of the cancers so discovered.

7. The public must be taught the earliest danger signals of cancer which can be recognized by persons without a special knowledge of the subject, and induced to seek competent medical attention when any of these indications are believed to be present.

8. Practitioners of medicine must keep abreast of the latest advances in the knowledge of cancer in order to diagnose as many as possible of the cases of cancer which come to them.

9. Surgeons and radiologists must make constant progress in the refined methods of technique which are necessary for the diagnosis and proper treatment not only of ordinary cases but of the more obscure and difficult ones.

10. There is much that medical men can do in the prevention of cancer, in the detection of early cases, in the referring of patients to institutions and physicians who can make the proper diagnosis and apply proper treatment, when the physicians themselves are unable to accomplish these results. The more efficient the family doctor is, the more ready he is to share responsibility with a specialist.

11. Dentists can help in the control of cancer by informing themselves about the advances in the knowledge of the causes of cancer, especially with relation to the irritations produced by imperfect teeth and improperly fitting dental plates. They can also help by referring cases of cancer which they discover to physicians skilled in the treatment of cancer in this location. It may be doubted whether all dentists fully realize the help which can be obtained from roentgen examinations in revealing not only the state of the teeth but the condition of the bone surrounding them.

12. Medical students should be instructed in cancer by the aid of actual demonstrations of cancer patients, and this to a sufficient extent to give them a good working knowledge of the subject.

13. The most reliable forms of treatment, and, in fact, the only ones thus far justified by experience and observation, depend upon surgery, radium and roentgen rays.

14. Emphasis should be placed upon the value of the dissemination of the definite, useful and practical knowledge about cancer, and this knowledge should not be confused nor hidden by what is merely theoretical and experimental.

15. Efforts toward the control of cancer should be made in two principal directions: (1) the promotion of research in order to increase the existing knowledge of the subject, and (2) the practical employment of the information which is at hand. Even with our present knowledge many lives could be saved which are sacrificed by unnecessary delay.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. Charles L. Martin, Dallas, Texas.
Twenty-eighth annual meeting, Montreal, Can., Sept. 20–23, 1927.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Washington, D. C., May 16–20, 1927.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Robert J. May, St. Luke's Hospital, Cleveland, Ohio.
Annual meeting, Milwaukee, Wis., Nov. 29–Dec. 3, 1926.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. Sherwood Moore, St. Louis, Mo.
Annual meeting, Atlanta, Georgia, Nov. 15–18, 1926.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. R. A. Arens, Michael Reese Hospital
Meets monthly on second Friday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. E. P. McNamee.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. Henry L. Ulbrich, 1130 E. Grand Blvd.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. M. C. Sosman, Peter Bent Brigham Hospital, Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. Eugene V. Powell, 217 East 42d St.
Meets monthly on second Monday, New York Academy of Medicine.

*Secretaries of societies not here listed are requested to send the necessary information to the editor.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. S. C. Davidson, Highland Hospital.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary, Dr. Davis Spangler, Dallas, Texas.

British Empire

BRITISH RÖNTGEN SOCIETY
Meets on the first Tuesday of each month from November to June inclusive, at 8.15 P.M., at the British Institute of Radiology, 32 Welbeck St., London; W. 1.

BRITISH INSTITUTE OF RADIOLOGY
Secretary, Dr. John Muir, 32 Welbeck St., London, W. 1.
Meets at 32 Welbeck St., but regular dates and times of meeting have not yet been arranged.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8.30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

RADIOLOGICAL SECTION, AUSTRALASIAN MEDICAL CONGRESS
Secretary, Dr. C. A. Anderson, The Hospital, Dunedin.
Meets at Dunedin, New Zealand, during February, 1927.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

CANADIAN RADIOLOGICAL SOCIETY
Secretary, Dr. E. C. Brooks, Montreal.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.
Meets annually.

Continental Europe

BELGIAN SOCIETY OF ROENTGENOLOGY
Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHOSLOVAKIA
Secretary, Dr. Walter Altschul, German University, Prag, II/52.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Torino, Torino.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs S. A. Reinberg and S. G. Simonson.
Meets annually.
Fifth Annual Meeting in Kiev, Ukraine, May, 1927.

LENINGRAD ROENTGEN RAY SOCIETY
Secretaries, Drs. S. G. Simonson and S. A. Novotelnow.
Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN
Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY
Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK
Meets in Copenhagen.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND
Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY
Secretary, Professor Holzknecht, Vienna, IX, General Hospital.
Meets on the first Tuesday of each month from October to July.

LETTER FROM ITALY

Ospedale Mauriziano, Turin
Sept 11, 1926

To the Secretary of the American Roentgen Ray Society:

It is with great sorrow that the Società Italiana di Radiologia Medica has received the news of the death of your much admired president, Dr. Russell D. Carman.

The members of our Italian Society beg me who had the pleasure to make his acquaintance last year in London and to admire his splendid qualities, to express to the American Society our sincerest grief and deepest sympathy in this very sad occurrence.

With best regards I remain,
Yours sincerely,
Secretary,
Società Italiana di Radiologia Medica

NEW ENGLAND ROENTGEN RAY SOCIETY

The first meeting of the New England Roentgen Ray Society was held at the Collis P. Huntington Memorial Hospital on Oct. 15, 1926, the president, Dr. P. H. Cook, presiding. The program was given by members of the hospital staff, as follows:

Dr. William Duane gave a talk upon his Sabbatical year spent in Europe, during which he studied the therapy and the research work in various clinics. He noted that most of the large institutions have a full-time physicist on the staff, and gave details as to their value in biophysical work. His second point was that nearly all of the newer therapy installations are of the constant potential type, with kenetron rectification; such machines being made by French, German, and English companies.

In regard to the measurements of doses he found two main types in use, one by the ionization current through a galvanometer and the other by the discharge of an electroscope. The majority preferred the ionization chamber and galvanometer, with the dose expressed in standard "e" units. The erythema dose varied widely, estimated from 400e to 1,400e. In his experience it was between 1,000 and 1,200e. Solomon's R unit is 2.5 times the e unit, which is used in Germany, England and America. He noted also that most men were using fractional repeated doses up to eight or ten in two weeks, rather than the massive dose previously advocated.

Drs. Minot and Isaacs reported studies on the blood of patients following irradiation. They stated that there is a change in

the *age* of the red cells during and after treatment, and said that if the number of old red cells increases shortly after treatment, the ultimate result of the therapy will be good. If there is no change, the effect is apt to be slight. They use this as a prognostic measure, particularly in leucemia.

They also reported that the white blood cells in the saliva alternate in number with those in the blood, particularly in cases of leucemia, and Dr. Isaacs demonstrated some interesting graphs to prove this point.

Dr. Minot particularly emphasized that the activity of a leucemic process is the best guide for treatment, especially the percentage of immature white cells, the metabolism (which is usually increased), the hemoglobin and physical signs. He also suggested that in advanced Hodgkin's of the Dorothy Reed type, where the lymphocytes are low, ultraviolet light therapy frequently gives beneficial effects.

In the third paper Dr. Greenough reported his impressions from the recent Lake Mohonk conference for the control of cancer, saying that it was the belief of the majority that cooperative work by a group of specialists, and education of the public and general practitioner in the early diagnosis of carcinoma, gives the best results in the way of treatment.

Dr. Bovie demonstrated a special diathermy machine with thermal cell control, so that a known heat could be delivered at the point desired.

Dr. Daland gave the clinical results with the use of this machine and was enthusiastic over the results in otherwise inoperable tumors, particularly with the "slow cutting" and "coagulation" currents.

In the final paper Dr. Taylor gave a clinical report on 195 hemangiomas and 13 angiosarcomas treated at the Huntington Hospital. It was his experience that the telangiectatic and the spongy type showed very good response to radium therapy, but that the "port wine" or diffuse, flat type gave poor or occasionally unsatisfactory results.

M. C. Sosman, M.D., Secretary-Treasurer

AN EXPERIMENT

WITH THE RADON APPARATUS OF THE UNIVERSITY OF MONTREAL

To the Editor:

The purpose of this note is merely to report an experiment made with the radon apparatus of the University of Montreal.

The plant has been in use for the last three years giving satisfactory service. From the beginning I had expressed doubts about the carrying away of the radium salt in solution, by the evaporating water vapor, and I therefore conducted a series of tests.

The first experiment with the water collected during one year in the trap located six inches above the radium container in the safe, revealed only an insignificant radioactivity after thirty days.

Recently, the water was taken out from the trap. That water had been carried to the trap during the two preceding years. The liquid sealed and properly tested was found to contain a certain quantity of radium salt that apparently came with the water vapor from the solution. The distance between the container and the trap seems too great to be traversed by the particles projected by the boiling of water *in vacuo*.

I submit these facts for the consideration of your readers.

J. E. Gendreau, M.D.
Director of the Radium Institute of Montreal.

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

SWEET IMPROVED EYE LOCALIZER CHART: HOW TO AVOID POSSIBLE MISINTERPRETATION

BY F. B. STEPHENSON, M.D.

DENVER, COLORADO

THE Sweet Improved Eye Localizer is on the whole a very accurate instrument, the sources of error lying in (1) the adjustment; (2) the cooperation of the patient; (3) the use of the average eye measurements as criteria; (4) the act of charting, and (5) interpretation of the chart. It is the latter procedure which I wish to discuss.

In the use of this instrument the measurements of distance in millimeters are calculated and reported with reference to horizontal and sagittal planes through the center of the pupil and also to a plane tangent to the pupil. These measurements are charted on three diagrams showing severally the horizontal, sagittal and transverse equators of an average eyeball. It is conceivable that a foreign body could be outside the eye and yet be so situated that it would appear inside either of the circumferences charted, when projected perpendicularly to their planes. The referring oculist, seeing these chartings, is apt to take the appearance of the diagrams as indicating whether the foreign body is within the eye and as showing its actual distance from the sclera—and even the roentgenologist, if he has not carefully studied the mathematical and projection features of this particular localization procedure, may fall into the same error.

Hubeny[1] makes the only reference to this difficulty which I have been able to find in the literature. He does not suggest a way of proving the case, and in fact, referring to border-line cases, makes the statement, "The following case illustrates the impossibility of determining this by means of the most precise method known, namely, localization."

[1] Hubeny, M. J. Localization of foreign bodies in the eye. *Radiology*, 1924, ii, 33–37.

Subjoined are illustrations of how the localization chartings might be taken to indicate that the foreign body lies within the sclera, while actually it is proven to be outside the eyeball. A simple method of making this determination on the diagram is explained.

The cut shows the "left" side of the Sweet Improved Localizer chart. The foreign body is reported (correctly) as lying 8 mm. below, 8 mm. to the nasal side of, and 20 mm. posterior to the center of the pupil. From these figures alone the oculist cannot visualize this position accurately enough to know whether it is outside the eyeball. He observes the chart and in each diagram the foreign body shadow appears inside the eye. It would be the most serious of errors if the roentgenologist so reported, or allowed such a reading to go by default.

On the lower diagram, the transverse line passing through the foreign body shadow is the measure (18 mm.) of the diameter of a transverse vertical section of the eye in the plane of the foreign body. Using half that measurement as a radius (9 mm.) revert to the upper diagram and, with compasses set in the center, draw the 18 mm. circle (dotted line in the diagram). One is now facing the pupil of the eye and it is seen that the foreign body is outside the circumference of the eyball at the plane in which it lies. The other circumferences may be charted out as shown in the other diagrams; however, one is sufficient—if the foreign body in *any* certain plane lies outside of the circumference of the eye in that plane, it is of course outside the eyeball. (Conversely, if in a given case the plane in which a foreign body lies happens to be a pupillary plane and the shadow is charted

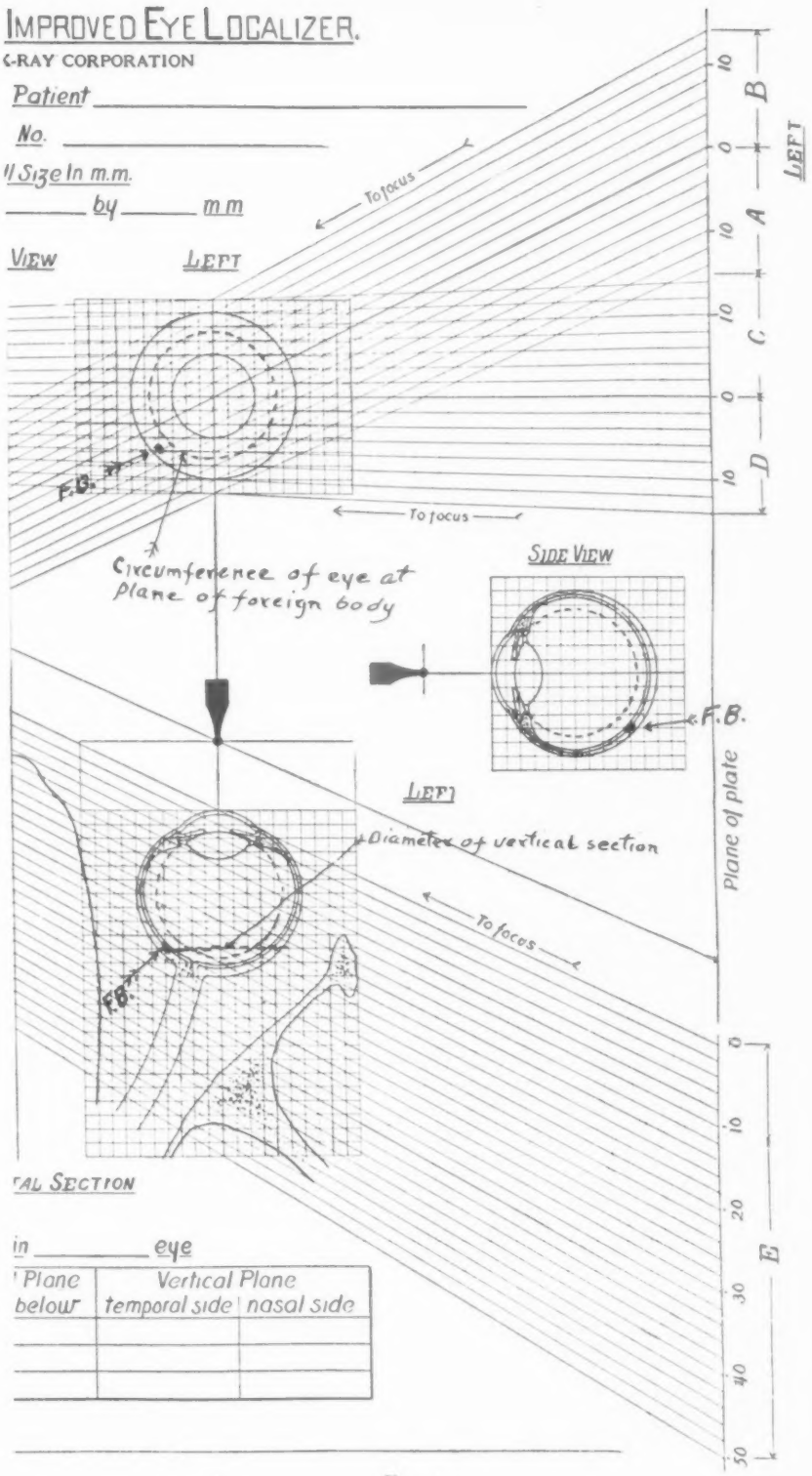

IMPROVED EYE LOCALIZER.
X-RAY CORPORATION
Patient
No.
Size in m.m.
by m m
VIEW
LEFT
To focus
F.B.
Circumference of eye at plane of foreign body
To focus
SIDE VIEW
F.B.
LEFT
Diameter of vertical section
To focus
F.B.
Plane of plate
AL SECTION
in eye
Plane below
Vertical Plane
temporal side
nasal side
LEFT
A
B
C
D
E
10
0
10
10
0
10
0
10
20
30
40
50

FIG. 1.

inside that equator, it is unequivocally within the eyeball.)

Conclusion. When a foreign body is charted on a Sweet Improved Eye Localizer chart and does not lie in either the sagittal, horizontal or transverse equatorial plane, its position can and should be checked with reference to the circumference of the eye in the plane in which it lies. Dependence on the appearance in the diagrams may be seriously misleading.

WATER SUPPLY FOR THE PHOTOGRAPHIC DARK ROOM

BY DAVID R. BOWEN, M.D.

Pennsylvania Hospital

PHILADELPHIA, PENNSYLVANIA

THE need of a plentiful supply of water ranging between 65 and 70°F. is universally recognized but, unfortunately, not universally carried out; and much of the ill quality of roentgen films is due to this one factor.

Occasionally the available water supply never goes above 70°F. and the problem is simply one of adding sufficient warm water to secure the proper temperature. In a few other cases proper refrigeration of a too warm supply is available because of a reasonably close relation with the hospital refrigerating plant.

By far the larger number of dark rooms have to depend upon ice for proper cooling of the water during the hot weather months, an irregular, expensive and often messy procedure.

If the available supply is never above 75°F. or a very little more, one of the newer individual refrigerating plants may be used with success. These are expensive and require a considerable amount of "service."

For these reasons the writer believes that, whenever possible, the water supply of the dark room should be pumped from a nearby well, this well being deep enough to insure a supply constantly below 70°F. It seems that a well 50 feet, or more, deep will usually yield water of a temperature not above 60°F. Such wells in Philadelphia have ordinarily given a temperature of about 54°.

A well drilled at the Pennsylvania Hospital during the present year, with a depth of 50 feet, has been very satisfactory. The temperature from April to September has not been lower than 64° nor higher than 67°. The drilling of this well and the installation of an electric pump of very ample capacity cost five hundred and thirty-six dollars.

This procedure is earnestly commended to the roetgen department of any hospital in which the temperature of the water during the hot months has been a problem.

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CONCERNING LEADED RUBBER APRONS

BY DAVID R. BOWEN, M.D.

PHILADELPHIA, PENNSYLVANIA

ALMOST important factor in the protection of the roentgenologist and his assistants from harmful radiation is the leaded rubber apron. No equipment is considered complete without at least one of these but far too many roentgenologists admit frankly the entire personal neglect of their use.

The writer believes that this is almost wholly due to the extreme discomfort of wearing these aprons, supported by a loop of tape hanging from the neck, as they are ordinarily sold. Suspended in this way the weight of an apron, containing enough lead to be of any use whatever, becomes so uncomfortable and burdensome that neglect of its use is, at least, pardonable.

For some years the writer has been accustomed to use suspenders passing from the waist line of one side across the opposite shoulder. This method came to mind after seeing Dr. Caldwell work with an apron suspended from a light metal yoke, bent so as to fit hookwise comfortably over each shoulder.

A trouble with the plain suspender harness is that the straps have to be so

long that the apron hangs too low from the chin; or so short that the hair is disarranged every time the apron is put on and off.

We have remedied this by cutting the non-elastic suspender straps at the front and fastening them on either side with a "lift-the-Dot" fastener such as is commonly used on touring car curtains. This division is also bridged by a 12 inch length of more slender tape (Fig. 1). To put on the apron the fasteners are left open and the straps are thus each one foot longer than their working length (Fig. 2), and can readily be slipped over the head without touching the hair. From this position it is very easy to bring the fasteners together and bring the apron as high up on the chest wall as is desired (Fig. 3). The comfortable fit of the apron thus suspended is well shown in Figure 4. It can be worn literally for hours without occupying one's attention in the least.

Note in Figure 1 the heart-shaped patch of adhesive plaster. This serves to identify, even in the dim light of the roentgenoscopic room, the body side of the apron. It aids in avoiding confusion from putting the straps on wrong side out and also serves to keep the same side of the apron always in contact with the clothing. Otherwise, particles of grease from tables or machines contaminating what was the outside of the apron yesterday and the inside to-day, would frequently soil the clothing.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

KEY, JOHN ALBERT. Epiphyseal coxa vara or displacement of the capital epiphysis of the femur in adolescence. *J. Bone & Joint Surg.*, January, 1926, viii, 53–117.

The term coxa vara should be limited to conditions in which the neck of the femur is intact and the head of the femur is in the acetabulum and not firmly ankylosed. In such a hip, when the extremity is maintained in a position of adduction or when the normal range of abduction is limited by bony deformity of the femur, coxa vara may be said to exist. The deformity may be in the head, epiphyseal line, neck, or trochanteric region of a femur. Now that roentgen rays are generally available, it is possible to classify coxa vara anatomically as well as etiologically. The following classification is made:

A. *Capital Coxa Vara.* 1. Legg-Calvé-Perthes' disease (osteochondritis juvenilis), (coxa plana). 2. Arthritis (hypertrophic, atrophic, or malum coxae senilis). 3. Destructive disease (tuberculosis, pyogenic, Charcot's disease, etc.).

B. *Epiphyseal Coxa Vara.* 1. Idiopathic. 2. Traumatic.

C. *Cervical Coxa Vara.* 1. Congenital deformity. 2. Congenital deformity in old reduced congenital dislocation. 3. Developmental or constitutional disease (rickets, achondroplasia, osteopsathyrosis, cretinism, osteogenesis imperfecta, osteitis deformans, osteomalacia, etc.). 4. Destructive disease (tuberculosis, osteomyelitis, syphilis, neoplasms, cysts, osteoporosis, osteitis fibrosa, etc.). 5. Fracture with malunion.

D. Trochanteric Coxa Vara. 1. Destructive disease as in C. 2. Fracture with malunion.

When used as a diagnosis, the term coxa vara should be preceded by the adjective locating the chief deformity and followed by the etiology, as: cervical coxa vara due to rickets.

Epiphyseal coxa vara is probably the most frequent cause of hip disability which begins in the adolescent period. Twenty-four cases seen at the Massachusetts General Hospital from 1904 to 1922 form the basis of the present communication. A fair average in a large orthopedic clinic is from 2 to 5 cases of epiphyseal coxa vara a year.

The histories of any large group of cases of epiphyseal coxa vara can be roughly divided into two classes: non-traumatic and traumatic. The non-traumatic or idiopathic type is nearly always characterized by a history of pain which may be confined to the hip but usually radiates to the lower thigh and knee. The pain, as a rule, is not severe and is not constantly present. In the traumatic cases the injury, as a rule, is a rather trivial one and not of sufficient severity to cause serious trouble in the average normal adolescent hip. The immediate effect of trauma varies; there may be very little disability with dull ache or else very severe pain and immediate total disability in the affected extremity. Occasionally there is a history of fracture of the femur. All gradations exist between this type and the non-traumatic case with gradual onset. During the active stage a slight trauma may cause an abrupt separation of the epiphysis with consequent modifications in the roentgenogram.

There are six main types of roentgenograms to be seen in epiphyseal coxa vara:

(1) Before any displacement has occurred the hip is essentially normal in appearance. The only abnormality visible is a questionable broadening and irregularity of the epiphyseal line.

(2) *Early Non-traumatic Type.* There may be slight rarefaction in the head and in the neck near the epiphyseal line. The acetabulum is normal in contour and the joint space is clear and of normal width. There is no evidence of arthritic change or of destruction of articular cartilage. The head of the femur is in the acetabulum, but is rotated so that its lower and posterior borders are displaced outward. The head is thinned out mostly in its upper half and appears to be enlarged in the vertical axis. The shadow of the head is crescent or sickle-shaped. The lower border of the head projects slightly as a beak-like process extending down beyond the line of the lower margin of the neck. The upper margin of the head is thinned out. The epiphyseal line is not visible above the upper border of the head. Where the head is in contact with the neck it is vague, irregular, broadened and almost vertical in direction. The femoral neck is normal in relation to the shaft of the femur, but its upper border is lengthened and roughly convex upward, while its lower border is shortened and appears to be more sharply curved upward than normally. The lower border of the neck is buried in the concave epiphyseal surface of the head, and is

thus apparently shortened. Between the border of the neck and the overhanging lower margin of the head some new bone formation is to be seen.

(3) *Advanced Non-traumatic Type.* The femoral head is markedly displaced and rotated so that only its upper and anterior half is in the acetabulum. Its articular surface is directed inward, backward and downward. The projecting lower border of the head curls outward and upward to approach the lower border of the neck. From this point the posterior border of the head can be traced curving upward and inward across the neck to approach the thin upper border of the head. The epiphyseal line is absent above and broad and irregular below where the head is in contact with the neck. It is inclined downward and outward. The neck is often thickened and its elongated upper border is less angular; its inner portion is smooth and rounded and in contact with the acetabulum. The lower border of the neck is sharply bowed upward and markedly shortened. The angle of the neck with the shaft appears to be decreased to about about 90°, and the whole neck is apparently bowed upward, the apex of the curve being the prominence marking the original mesial extremity of the upper border. The acetabulum is enlarged in the vertical diameter and the pelvis is slightly deformed on the affected side. There is definite alteration of the bone structure of the femur. The head is moderately atrophic, especially in its projecting lower half. There is some rarefaction of the upper portion of the neck and the dense lower border (Adam's bow) is thicker than normal. The joint space is clear and there is no evidence of arthritis.

(4) *Early Traumatic Type.* The head is separated from the neck and lies in the acetabulum. It is rotated obliquely so that its lower and posterior borders are out of the acetabulum and applied to the neck of the femur. The head is normal in contour and its articular surface is directed downward, inward and backward. The femur is displaced upward and externally rotated, the upper border of the neck being in contact with the acetabulum and the lower border is imbedded in the cancellous tissue of the epiphyseal surface of the head. The neck points upward, inward and forward. There is no bone atrophy. The joint line is apt to be rather hazy from extravasated blood. Except for the displacement of the head upon the neck, the contour of all the bones is normal.

(5) *Late Traumatic Type.* The head is firmly fixed in its new position on the neck by callus and new bone. With time the upper border of the mesial extremity of the neck is rounded off and with the upper and anterior part of the head enters the acetabulum to form the hip joint. The condition resembles the late non-traumatic epiphyseal coxa vara described above. The only difference between them is that in the traumatic type the head becomes markedly atrophic but retains its normal contour for several years.

(6) In adult life, idiopathic traumatic types are indistinguishable. The epiphyseal line has disappeared and the head and neck appear as a solid mass of bone. The neck may appear elongated and bowed upward with the lower border of the head projecting below. More frequently the neck is thickened and shortened. In this type with the enlarged mushroomed head, the roentgenogram of the hip in adult life resembles that of an old Legg's disease. The acetabulum is enlarged to accommodate the head of the femur and in later life arthritic changes develop in the hip.

It is emphasized that the above six subdivisions are purely arbitrary and made for the purpose of description. There are only two types of epiphyseal coxa vara, namely, the traumatic and the non-traumatic; and the roentgenograms of these in the early stages are characteristic. It is to be noted that all transitions between the early and late stages of each type occur and a non-traumatic type may by trauma be converted into a typical traumatic type.

Our knowledge of the pathology of epiphyseal coxa vara is still inadequate to explain the condition. The etiology is also a subject for controversy. It has been noted in the roentgenograms that in some instances the epiphyseal line of the opposite hip seemed to be unusually broad and well defined. It is not difficult to imagine that during the period of rapid adolescent growth the periosteum spanning the epiphyseal line is stretched, thinned and consequently weakened, thus permitting the head to be easily loosened. Is this a disease or is it physiological?

The traumatic or chronic hip beginning in adolescent life has about a 50 per cent chance of being a slipped epiphysis. The prognosis depends upon what is going to happen to the involved hip and whether or not the condition will become bilateral. It appears that about 15 per cent of the cases reported in the literature were bilateral.

A bibliography of 102 references is appended.

Kienböck, Robert. Osteoporosis. *Fortschr. a. d. Geb. d. Röntgenstrahlen,* 1925, xxxiii, 862–864.

A review of the subject from the roentgenological standpoint is presented. The study of

osteoporotic conditions is greatly aided by the roentgenographic method. The atrophy appears in the roentgenogram as a rarefaction of the normally dense bone shadow, the picture showing a distinct, wide meshed appearance of the bone structure. The author distinguishes between resting or stationary osteoporosis and the active or mobile form. In the latter case there is a rather rapid progressive or regressive change. There is also a simple uniform type of osteoporosis with thin periphery and wide meshed structure of the spongy mass with retention of the "uniform" spongious structure. Distinct from this is the fairly non-uniform osteoporosis with resulting "static" readjustment (the latter as in Paget's bone disease). Still another form is the completely non-uniform osteoporosis showing changes such as abscess cavities and tumor nodules; this group includes the small and large cystic changes of the bone due to atrophic processes and especially due to hemorrhages caused by the most diverse inflammatory and neoplastic conditions. Besides eaten-out and altered zones, one often also finds condensed and thickened areas.

There are four important classes of osteoporosis, the term applying only to internal bone atrophy. These classes are as follows:

A. Simple or genuine osteoporosis (1);
B. Non-genuine, diseased, complicated osteoporosis;
   (a) Diseased atrophic-dyscrasic osteoporosis (2);
   (b) Destructive osteoporosis:
      (α) Inflammatory osteoporosis (3);
      (β) (Malignant) neoplastic osteoporosis (4).

These various forms of osteoporosis are discussed and their subdivisions considered. Simple, genuine osteoporosis may be either chronic or acute in form. The second important group mentioned above (atrophic-dyscrasic osteoporosis) includes rickets, malacia, osteopsathyrosis, and arthritis deformans Paget, which have many features in common. They are all generally benign, slowly progressive, causing a softening and fragility of the skeletal structure. The fractures resulting are very similar in these diseases. A fourth disease belonging to this group is Barlow's disease (scurvy of children).

The third main type of osteoporosis (inflammatory osteoporosis) includes various forms of osteitis and osteomyelitis due to coccus infections, tuberculosis and syphilis. The neoplastic form of osteoporosis is mostly of the malignant type. The tumors that may be present are osteomas, chondromas, Dupuytren-Nélaton bone disease and multiple Engel-Recklinghausen bone tumors; sarcomas, angiomas and endotheliomas, myelomas and lymphomas, and tumor metastases.

The roentgenograms in osteoporosis frequently offer great difficulties in interpretation for three reasons: (1) One actually sees only the calcified portions of the bone masses, thus obtaining a one-sided idea of the anatomical changes; (2) practically all varieties of bone changes are to be seen in approximately all types of bone diseases (that is, so far as the roentgenographic picture is concerned); (3) the present stage of our knowledge is still very primitive. Nevertheless, most of the usual typical cases can be diagnosed indirectly from the roentgen picture with a large degree of certainty.

Kohlmann, Gerd. Symptoms and roentgen diagnosis of duodeno-colic fistula. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1925, xxxiii, 554–561.

The classic roentgenological sign of duodeno-colic fistula is the rapid passage of barium paste from the duodenum into the large intestine in cases usually with a healthy stomach. A portion of the paste travels down the small intestine. The fact of the existence of a fistula is further confirmed by the presence the next morning of contrast material in the stomach which had emptied in normal time. Symptoms common to both gastro- and duodeno-colic fistulae are fecal vomiting and diarrhea with fatty stools. These two types of fistulae may be easily distinguished in roentgenographic examination since the gastro-colic fistula is found where a diseased stomach forms a connection with the left portion of the transverse colon, while on the other hand, in the duodeno-colic fistula the stomach is, as a rule, healthy and the duodenum forms adhesions with the right half of the transverse colon, the ascending colon or the cecum.

In general, roentgen examination with barium yields more information of diagnostic importance in the case of gastro-colic fistula than in the other. The procedure is, however, of importance in the demonstration of colonic stenosis and is always to be performed; and it should show the stomach and duodenum entirely free of contrast material. Symptoms of ileus of medium intensity, although usually absent, do not necessarily exclude these two forms of fistula.

Absence of trypsin and the occurrence of fatty stools should not be considered a definite sign of carcinoma of the pancreas since fatty stools very frequently occur in gastro- and duodeno-colic fistulae. The entrance into the

duodenum of fecal material from the colon leads to disturbances in liver and pancreas function presumably through ascending infections by colon bacilli. This explains the occurrence of urobilin and urobilinogen in the duodenal juice and also occasionally absence of trypsin.

A careful analysis of all the clinical and roentgenological symptoms is necessary in order to establish a correct diagnosis of duodeno-colic fistula. This and gastro-colic fistula are found mostly in men of advanced age. A case occurring in a man aged fifty-five is described in detail and the subsequent autopsy findings are given.

Kolodny, Anatole. Angio-endothelioma of bone. *Arch. Surg.*, April, 1926, xii, 854–866.

In the Registry of Bone Sarcoma there are listed as angio-endothelioma, cases Nos. 154 and 291. There was considerable opposition to and criticism of the diagnosis by some of the leading consulting pathologists of the Registry. The author analyzes these two cases in an effort to determine whether angio-endothelioma of the bone is a true pathological entity.

This condition is exceedingly rare. It is emphasized that unless the diagnosis is made only after all the evidence is clear and conclusive the term endothelioma will merely serve as a catch-all for unexplained or poorly understood complex tumors.

The author proves that angio-endothelioma of the bone is a true pathologic entity by the fact that the tumor cells can be traced to the endothelium of the blood vessels and from the morphological features of the tumor cells, the intimate attachment of the groups of tumor cells to the surrounding tissue, and the frequent occurrence of intact blood in the alveolar lumen. It is believed that all these features evaluated together define the pathologic condition as a distinct entity.

Kolta, Erwin. A case of right-sided diaphragmatic hernia. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1925, xxxiii, 565–567.

A case is described in a boy aged seventeen. The roentgenologic examination showed the following: In the right side of the thorax, lying against the mediastinum, there was a circular shadow the size of a child's head and having a sharp outline. This shadow was of medium density and in its upper portion there was a linear extension of its outline, below which could be seen a light zone representing an air bubble with a horizontal lower boundary. This horizontal boundary showed a wavy motion when the patient was passively moved. The lower portion of the shadow was located at the diaphragm. The movements of the diaphragm were only sluggishly followed by the shadow. The heart was shifted somewhat toward the left. Ingestion of thin barium paste showed the contrast material to pass without hindrance through the esophagus which was shifted somewhat toward the right and then into the shadow lying in the thorax and finally the material sank below the diaphragm and travelled beneath the left diaphragm in thin streaks.

This picture clearly indicated a right-sided diaphragmatic hernia containing the distal portion of the stomach. Operation disclosed the presence of the distal portion of the stomach and the duodenum within the hernia.

Only a few hours intervened between the time of admission and operation, but this sufficed for a fairly definite roentgen diagnosis of the condition. The pictures showed the presence of the stomach in the hernial sac and there was practically no movement of the upper boundary of the shadow with the remaining portion of the diaphragm. It is of course clear that a true or false hernia cannot be distinguished roentgenologically.

Krebs. The problem of chronic arthritis and its roentgenological interpretation. *München. med. Wchnschr.*, Aug. 14, 1925, lxxii, 1375–1377.

The involvement of the muscle ends, tendons and tendon sheaths in the various forms of chronic arthritis is so common and complicates the disease picture to such an extent that a careful palpation in the examination of the joint is especially to be recommended. This involvement is frequently the major cause of complaint and when diagnosed can be satisfactorily treated. It is, of course, well known that the roentgenogram of the chronically diseased joint is a very important aid in establishing the diagnosis in chronic arthritis. Its interpretation, however, demands a very critical attitude and should be made only in connection with all the clinical data of the case.

Küpferle, L. The anatomical analysis of the röntgen picture in phthisis of the lungs. *Brit. J. Radiol.*, 1925, xxx, 416–419.

Valuable information can be obtained from the roentgenogram regarding the seat and extent of the disease in pulmonary tuberculosis. The diverse shadows seen in the picture require not only a descriptive but also an anatomical interpretation. Comparative examinations of the roentgenogram of the lung and the corresponding anatomical changes show that the most important forms of reaction to tuberculosis, viz., the productive and the exudative

forms, are well recognizable in the roentgenogram. Likewise the character and extent of the reparative process (cicatrization and healing) and the secondary changes of necrosis and cavity formation can also be easily interpreted.

The anatomical interpretation offers an excellent index of prognosis and treatment in special cases. Serial roentgenograms taken at different intervals will indicate the progress of the disease, whether it be a healing process or the reverse.

The productive form of pulmonary tuberculosis is characterized in the roentgenogram by well-circumscribed shadows of the foci, of different size and clearly separated from each other. The exudative reaction, on the contrary, produces diffuse shadows which gradually grow lighter at the periphery and look very much like bronchopneumonic foci. Scar tissue produces particularly dense, irregularly shaped shadows, surrounded by lighter speckled shadows due to the deformed, shrunken and atelectatic tissue of the lungs.

The most frequent cavities are those in the back and upper parts of the lungs. The determination of the location and extension of the existing cavities is one of the most difficult and important diagnostic tasks of the roentgenologist. Experience alone, based on extensive anatomical comparisons will permit an absolutely definite localization of existing cavities.

Langer, Hans. The relations between tuberculous infection and exposure, as seen in the roentgen picture. *Ztschr. f. Kinderh.*, 1925, xxxix, 60–73.

The author made systematic roentgen examinations of children from tuberculous families—children who had become exposed, and one might say had been definitely infected with tuberculosis. The object was to discover how far these early infections had resulted in actual tuberculosis. It was recognized that the roentgen examination was of limited application in the diagnosis of active tuberculosis. The diagnosis of the disease was based largely on the clinical features, and the roentgenological search was practically entirely for calcified processes.

The study included 90 children coming from 42 families; 63 children in 33 families were regarded as seriously menaced. In this latter group there were 30 children one year old at the time of exposure; of these there are 6 at the present time clinically ill with pulomary tuberculosis (3 under four years of age); there are 12 showing calcifications (1 under four years of age); 3 show doubtful calcifications; and 9, all under four years of age, show no pathological signs.

There were 29 children in the seriously exposed group who were two to five years old at the time of exposure. In this group there was one clinically tuberculous; 11 showed calcified areas, and 4 doubtful calcifications. Amongst all of these there was not a single individual under four years of age. The remainder of the group, 13 in number, showed no positive signs, and only one of these children was under four years old. It would appear therefore that children infected with tuberculosis or seriously exposed to it during the first year of life either become tuberculous (but only in very few cases), or else, as is shown in the majority of cases, overcome the anatomical tuberculosis and give definite evidence of it in calcified processes.

It would therefore seem that the prognosis even in early, seriously exposed cases is not unfavorable, and this is not due to slight exposure but to a remarkably pronounced ability in overcoming even severe primary infections. Calcifications develop in the young child fairly slowly; such calcifications due to infections in infancy begin to appear, as a rule, at four years of age. The repeated finding of numerous calcified areas in the lungs indicates the prevalence of superinfections in the young child and their importance in aggravating the symptoms. The roentgenological findings have demonstrated quite clearly that very young children in families with open tuberculosis are not entirely helpless in the face of this exposure.

Laurell, Hugo. Other contributions to the roentgenology of abdominal mixed tumors. *Acta radiol.*, 1925, iv, 480–498.

The author reported in 1922 upon 3 cases of bone- and tooth-containing abdominal mixed tumors, in 2 of which cases the roentgen examination was definitive. The diagnosis in the hitherto published cases of roentgenologically diagnosed dermoid cysts and teratomas was dependent upon the presence of tooth and bone nuclei. A portion of the dermoid cyst may cast a negative shadow because of its high fat content. Consequently a roentgenological picture showing a rounded negative shadow in the abdominal region should in all cases be checked, and an effort made to take into consideration all possible sources of error.

Reports are given of 2 additional cases of ovarian dermoid cysts containing bone and tooth structures. The first occurred in conjunction with an acute intraperitoneal abscess; and in the second case the finding was made incidental to a general abdominal examination while following up the results of extirpation of the left breast for cancer done two years pre-

viously. In the latter case the tumor had never caused any symptoms.

Laurell, Hugo. Free gas in the abdominal cavity. *Acta radiol.*, 1925, iv, 590–602.

The roentgenological demonstration of free gas in the abdominal cavity may be a valuable support to the diagnosis of peritonitis due to the perforation of a gas-containing part of the stomach or intestines. But free gas can also occur in the abdominal cavity as the result of other conditions, so that the roentgen diagnosis of a perforating peritonitis after the establishment of the presence of free gas must also be built on the anamnesis, clinical data and other roentgen signs.

Free gas can be met with during the weeks immediately following an abdominal operation, and also after a laparoscopy and a previous pneumoperitoneum, intentional or spontaneous. Free gas can also arise as a consequence of the bursting of a gas bubble in pneumatosis cystoides intestinorum and possibly also after the bursting of interstitial subserous bubbles due to other etiology.

Free gas in large amounts can, according to Stegemann, occur through the action of gas-forming bacteria and also when the peritoneum shows an inflammatory irritation of a small and limited area. It may also occur when a gun shot has lodged in the liver and given rise to a gas abscess or phlegmon. In a superficial examination, the intestines lying between the diaphragm and the liver may lead to confusion with free gas. Such an interposition may arise not only when some part of the gut is abnormally distended with gas, but also when there are intramural gas bubbles, as in the case of intestinal pneumatosis cystoides. Moreover, subserous bubbles below the diaphragm where such bubbles have been observed in rare cases of pneumatosis, may give rise to confusion. One must also keep in mind subdiaphragmatic interstitial emphysemal bubbles of other origin and of retroperitoneal gas phlegmons extending to the under surface of the diaphragm.

One may inquire whether occasionally small air bubbles remaining in the abdominal cavity after an operation or having reached there in connection with perforation may not cause the spread of microbes in the abdominal cavity, for instance, in the subphrenic cavity, through the bubbles moving from one place to another when the position of the body is changed. In diffuse peritonitis with free gas a number of roentgenological observations may be made such as diminished movement of the diaphragm, a secondary pleuritis (often only very slight, but none the less an important sign), intestinal obstruction and signs of a slight exudation in the abdominal cavity.

The roentgen examination of free gas can be carried out quickly and with little pain. It is only necessary to turn the patient in bed to one side, the left if possible, and to transilluminate or take a roentgenogram of the highest part of the abdomen with the rays horizontal.

Lenk, Robert. Displacements of pleural exudates by change in position, and their diagnostic significance. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1925, xxxiii, 673–675.

Contrary to general belief, the author found that inflammatory exudates in the pleural space are, as a rule, easily movable. It is only in the advanced case where pleuritic adhesions have undergone marked development that the shadow of the exudate remains unchanged when the patient changes his posture. This condition was found in only 3 out of 37 cases observed by the author. Several cases are cited.

The fact of the mobility of pleural exudates is of practical as well as of theoretical importance. In a differential diagnosis between exudate and pleural induration the shadow displacement is of importance. Such a case is briefly cited. It may happen that an exudate settling out in the lower portions of the pleural space may cover up a pathologic process in the lung tissues, and in such cases an attempt to displace the fluid may reveal the condition.

Maclaire, A. S. Lipiodol in neurosurgery. *Am. J. M. Sc.*, December, 1925, clxx, 874–880.

The author's experience with lipiodol has been limited to 3 cases. One of these is here reported and has convinced the author of the irritative nature of this substance.

The case reported was in a man aged thirty-seven, a laborer, who complained of difficulty in locomotion for the past two and a half years. At the age of fifteen the patient had fallen 15 feet and sustained a cranial and vertebral injury. The general physical examination was negative, with the following two exceptions: A linear cranial defect in the right frontal bone one inch wide and 5 or 6 inces long, and a kyphosis of the vertebral column at the fourth thoracic vertebra. The cranial defect pulsated. A cisterna magna puncture was performed with the intention of introducing lipiodol into the spinal canal to verify the level of compression obtained by the neurologic examination. Ten c.c. of the spinal fluid was removed and 1 c.c. of liopiodol injected. The lipiodol employed was the same material as used by Sicard, and was imported from France. The following day another lumbar puncture was performed and a

few cubic centimeters of spinal fluid were removed. One c.c. of lipiodol was introduced at the lumbar site and the patient turned, with the buttocks elevated, so that the oil could gravitate to the site of the obstruction. The roentgenograms showed the opaque material opposite the seventh, eighth and tenth dorsal vertebrae. This localization did not correspond with the clinical diagnostic level, which was the eighth dorsal segment and would be opposite the sixth thoracic vertebra. The difference was so small that it was felt to be confirmatory evidence of spinal obstruction and compression. The preoperative diagnosis was compression fracture of the fourth dorsal vertebra with meningo-myelitic adhesions extending from the eighth to the eleventh dorsal segments. The operation disclosed compression fracture of the fourth dorsal vertebra, fusion of the fifth and sixth, and an incomplete transverse myelitis of the cord, together with some chronic post-traumatic arachnoiditis.

The patient returned about five months after his discharge from the hospital in a markedly worse condition. The neurological examination suggested a possible diagnosis of multiple sclerosis. The roentgenogram of the spine showed a portion of the lipiodol lying opposite the seventh, eighth and tenth thoracic vertebrae. Another laminectomy was performed and dense recent leptomeningeal, as well as meningomyelitic adhesions were found. The arachnoid was very much thickened and it was concluded that the damage noted at this operation had been produced since the last exposure of the canal. Two arachnoidal cysts, one the size of a green pea, and the other the size of a kidney bean lying opposite the eighth and tenth dorsal segments contained lipiodol. It is felt that these encysted masses aside from producing spinal cord compression had recently caused an inflammatory process which resulted in the new lesions. The patient was discharged without any improvement resulting from the operation.

The author concludes that lipiodol may be regarded as irritating if left within the subarachnoid space indefinitely. It is advisable not to employ this new material as a means of localization except as a last resort, and only if laminectomy is to follow within a few days. The oil could then be removed from the intradural space.

MEISELS, EMIL. Torsion of the stomach. *Acta radiol.*, 1925, iv, 363-367.

A description is given of a case in which the pars pylorica was found below the lower pole of the spleen as a result of twisting of the stomach 1800 about its long axis. The lack of acute symptoms is characteristic of a gastric torsion.

The man, aged twenty-six, had been suffering for several years from periodic gastric disturbances. The physical examination was entirely negative. There was slight gastric hyperacidity, but occult blood was not demonstrable. The stomach sound was inserted without encountering any resistance.

The roentgen examination showed a very unusual picture. Barium paste traversed the normal esophagus and entered the cardia without hindrance. The contrast fluid slowed down somewhat for a few seconds at the beginning of the pars media and then rapidly entered the pars media and pylorica. These two showed a very abnormal position. The pylorus was turned toward the left and lay underneath the spleen and ran upward from right toward the left.

The stomach was hookshaped and of good tonus. The lowest point of the large curvature was at the level of the navel. The contours were smooth and uniform except at the boundary between the cardiac and median portions. Here there was a slight contraction which became accentuated with peristalsis. The time of emptying of the stomach was normal.

The origin of this anomaly is not clear. It may be a congenital malformation but the possibility of abnormal adhesions, for instance between the pylorus and the spleen, has not been excluded. Torsion of the stomach should be distinguished from volvulus of the stomach. The former involves the rotation of the lower portion of the stomach around the longitudinal axis and occasions no stormy symptoms; on the other hand, in volvulus there is, in addition to the longitudinal rotation of the upper portion of the stomach, also a rotation around the horizontal axis, thus producing symptoms suggesting ileus.

MELVILLE, STANLEY. Pleural rings. *Brit. J. Radiol.*, 1925, xxx, 456-459.

The difference between the so-called pleural ring and the cavity in a lung may be stated as follows: (1) the pleural ring or rings are seen when there is no suggestion of any clinical evidence of excavation; (2) in appearance the pleural ring may be circular or oval but the periphery is of equal thickness all around, nor is there the irregular area of consolidation present as in the case of a cavity, nor is the more or less crenated edge of the ordinary cavity to be seen. The pleural ring is a type of plastic pleurisy in which the visceral and parietal pleural surfaces are adherent; but the author believes the adhesion is at least so slight that the admission of gas into the pleural cavity is quite sufficient to separate them.

A summary is given of a case demonstrating the following features: A definite typical pleural ring was found in the left upper zone. When artificial pneumothorax was induced the ring disappeared. Some months later the lung having re-expanded was roentgenographed and the pleural ring was no longer visible. These facts seem to demonstrate that there could have been no adhesion of the pleural surfaces; that the exudate disappeared on collapsing the lung; and that the pleural ring was what it was regarded to be and not a cavity, for it was not seen in the lung upon decompression.

MEYER, HERMANN. Pneumoperitoneum as a method for examining the gastrointestinal canal. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1925, xxxiii, 509–527.

Pneumoperitoneum offers so many striking advantages in the examination of the abdominal organs that it would seem important to make an experimental study of this method. A number of experiments were made on a dog to learn the effects upon the gastrointestinal canal of increased pressure, displacement of the organs, drying of the serous surfaces and absorption of oxygen. A number of preliminary experiments were made in which the dogs did not receive intraperitoneal gas injections to determine the normal periods of the gastrointestinal function under standardized feeding conditions. It was found that pneumoperitoneum tended to produce a considerable delay in the emptying time of the stomach as compared with the normal. This condition was very much improved when the feeding time was separated from the air injection, and it is therefore concluded that psychic effects play an important part. Pressure, displacement and drying within the abdomen cannot play any very important rôle.

Duodenal motility was observed distinctly in all detail with the aid of pneumoperitoneum. In a few cases the rhythmic segmentation in the small intestine was rather poor and in certain other cases it was established that the rhythmic segmentation produces a certain forward motion of the contents. The main filling is complete in about two hours and the emptying requires 4¾ hours as compared with the normal period of four hours and twenty minutes. Here also there is a slight delay occasioned by the pneumoperitoneum.

In the large intestine pneumoperitoneum brings out distinctly the mixing and peristaltic movements. No change was observed in the filling or emptying time of the large intestine.

The experiments have clearly demonstrated that pneumoperitoneum is a very useful method provided the gas injection is admioistered sometime before the filling of the stomach, and the latter should be done gradually with small quantities and with least disturbance to the individual.

MEYERDING, HENRY W., CARMAN, RUSSELL D., and GARVIN, JOHN D. Metastasis to the bones from carcinoma of the breast: A roentgenologic study. *Radiology*, December, 1925, v, 486–489.

In every case of carcinoma of the breast, and in cases of middle aged women with or without a definite history of carcinoma of the breast, who complain of "rheumatic" or "sciatic" pain, the possibility of metastasis to bone should be considered. Since it is impractical to make a roentgen-ray examination of the bones in every instance, much depends upon the judgment of the clinician. Moreover, since metastasis may indicate certain other lesions, the roentgenologist should be careful not to overlook it, and in doubtful cases he should cooperate actively with the clinician. The records of 1985 cases of carcinoma of the breast examined at the Mayo Clinic during the past six years disclose the occurrence of metastasis to the bones in 67 cases (3.48 per cent). Three of these cases were in males. Many of the patients did not appear very ill nor had they lost weight markedly. In 3 cases fracture from trauma insufficient to cause fracture of normal bone was the first sign. In 2 cases there was no reason to suspect metastasis which was discovered by routine roentgenological examination.

In the order of frequency the bones involved were: pelvis, 38 per cent; femur, 34 per cent; lumar spine, 31 per cent; ribs, 26 per cent; dorsal spine, 16 per cent. There was multiple bone involvement in 64 per cent of the cases. When the pelvic ring was affected, the metastases were about equally divided between the ilium, ischium and pubis. In the femur the lesion was usually in the upper third. Out of 36 cases in which there was metastasis to the spine it was confined to a single vertebra in but 4 cases. The average time between operation and discovery of metastasis was 31.3 months. In 25 cases with definite records, death occurred on an average of 4.7 months after the discovery of metastasis.

Preoperative radiotherapy was given in 12 cases and the average time of metastasis to bone was 20 months. Postoperative radiotherapy was given in 35 cases, metastasis occurring 24.7 months after operation. In 8 cases in which no postoperative radiation therapy was given the average time was 37 months. The fact is mentioned that radiation

therapy was omitted in the more favorable cases.

The metastatic lesions are commonly of the osteoclastic type, and are characterized roentgenologically by a honeycombed appearance, with a marked decrease of density and mottling in the affected areas. Rarely, if ever, is there a purely osteoplastic type but occasionally there are mixed types. Roentgenological simulants of metastasis include osteoporosis resulting from disuse, multiple myeloma, osteomalacia, sarcoma, osteomyelitis, osteitis fibrosa cystica and Paget's disease.

Moore, Sherwood. The development and application of cholecystography. *J. Missouri M. Ass.*, January, 1925, xxiii, 17–21.

Lessening of the morbidity in cholecystic disease can be attained by surgical means, particularly if employed early. The bar to this early surgical intervention has been the inadequate diagnostic means. Cholectystography makes possible the earliest and surest diagnosis employing a specific function of an organ to bring about artificial contrast of density.

Nagel, Gunther W. Unusual conditions in the duodenum and their significance. *Arch. Surg.*, October, 1925, xi, 529–549.

The three unusual conditions discussed are membranous obstruction of the lumen of the duodenum, diverticula and carcinoma. A case of membranous stenosis in an adult is added to 7 similar cases reported in the literature. Although rare, the possible presence of such a condition should be considered if no other cause for a chronic high intestinal stenosis can be found. This case occurred in a man, aged seventy-two. The roentgen-ray examination disclosed a dilated stomach but no demonstrable lesion. The diagnosis was pyloric obstruction of unknown origin. At necropsy the lumen of the duodenum was found partially closed 1.5 cm. above the ampulla of Vater by a transverse septum 5 mm. in thickness at its attachment and tapering down toward its center, where there was an oval opening 8 mm. in its greatest diameter.

Twenty-six duodenal diverticula of developmental origin are presented. All were incidental findings at necropsy Nineteen diverticula secondary to diseases in or near the duodenum are described. The majority were associated with duodenal ulcers and the symptoms were those of this disease. Small, non-inflamed diverticula require no treatment, but the larger ones should be inverted into the lumen of the bowel or removed by plastic operation.

Three specimens showing secondary involvement of the duodenum by malignant growths are described. Slight involvement of the duodenum was found in 5 of 14 cancers of the pylorus seen at necropsy. Cancer of the duodenum may be either secondary or primary, and it is usually impossible even at necropsy to diagnose with certainty a primary carcinoma of the duodenum. Nine patients with malignant stenosis of the duodenum are presented. Such cases are difficult to diagnose clinically and the prognosis is uniformly bad.

In considering diseases of the duodenum, their diagnosis and treatment, undue prominence should not be given these unusual conditions. However, a knowledge of rare lesions is an essential supplement to a thorough understanding of the diseases of any organ and occasionally must prove useful in practice.

Nicolaysen, Lyder. Right-sided idiopathic lifting of the diaphragm. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1925, xxxiii, 561–562.

Attention is directed to a case described by Bayne-Jones in a sailor aged fifty-two. The diaphragm showed paradoxic movements and the liver filled the dome-shaped area formed by the lifted diaphragm.

A case is described observed by the author in 1921. The patient was a woman aged twenty-three, who was suspected of having a subphrenic abscess and was examined roentgenoscopically. The right diaphragm was very much higher than the left and remained practically motionless during respiration. A test puncture revealed nothing. She was re-examined a year later and the roentgenological findings were the same, although the patient was feeling in the best of health and able to attend to all her duties. These findings were confirmed once again in an examination made five years later.

Nicolis, Naldo. A case of multiple congenital malformations of the spinal column. *Radiol. med.*, April, 1926, xiii, 266–271.

A woman, aged forty-three, who three years ago had begun to show slight signs of compression of the spinal cord which, however, had not grown worse, showed the following malformations in the roentgenogram: Dorsal scoliosis convex to the right and lumbar scoliosis convex to the left; the 3d and 4th dorsal vertebrae were divided, with separation of the two halves. The 11th dorsal vertebra looked as if made up by the incomplete fusion of two cuneiform hemivertebrae, resulting in an angular deviation of the intervertebral space between it and the vertebrae above and below. The lower border of the 10th and the upper margin of the 12th vertebra had adapted themselves to the form of the 11th. The first lumbar vertebra was made up of two cuneiform hemivertebrae

converging toward the median line without a trace of fusion. The 2d and 3d were almost normal; the body of the 4th had an irregularly pentagonal form. A spur projected from the lower half of this vertebra which ran about 3 cm. downward and stopped about 1 cm. from the ilium. The 5th was made up of two hemivertebrae, the left one of which had fused with the vertebra above while that on the right had remained free. The 6th was flattened, with irregular and poorly defined outlines. The lumbar segment therefore was made up of six outlines. The lumbar segment therefore was made up of six metameres. There was an extensive scission of the posterior arches of the last two dorsal and first two lumbar vertebrae, partial fusion of the two first ribs on the right and an arthrosis between the head of the 4th rib on the left and the anterior surface of the third dorsal vertebra. Roentgenograms of the deformed spinal column are given.

Nielsen, Lars. The disease picture of arteriosclerosis in the peripheral vessels and its differential diagnostic significance in the roentgenogram. *Münchcn. med. Wchnschr.*, July 10, 1925, lxxii, 1143–1144.

Arteriosclerotic changes of the vessels should be suspected as the cause of chronic painful disturbances in the fleshy portions of the extremities, especially the legs, in older persons. This condition is present more frequently than is suspected. In diagnosis, this condition is frequently difficult to differentiate from rheumatism, tabes, alcoholism, varices, or even functional neuroses. The recognition of its arteriosclerotic nature and the institution of proper treatment is considerably aided by the roentgen examination.

In a number of cases occuring in men between the ages of sixty and seventy-five years, the clinical diagnosis was extremely doubtful until the roentgenograms were examined. The latter showed straight shadows with very distinct double outline; here and there could be noted small delicate calcified plaques; and in 2 cases thickened tortuous calcified vessels could be seen. In some cases the anterior tibial artery was involved and in others the posterior, while some cases showed both of these affected. Very frequently calcification was observed not only in the arteries of the foot, but also in the vessels of the rete calcaneum. Pain from flat foot in older persons should suggest arteriosclerosis as a possibility. It is suggested that the pains occurring in mild cases of arthritis deformans are probably better explained as being caused by the arteriosclerosis that can be demonstrated roentgenologically, than by the arthritis.

Noble, T. P., and Hauser, E. D. Coxa vara. *Arch. Surg.*, February, 1926, xii, 501–538.

Coxa vara of unknown etiology may be divided into two groups, congenital and adolescent. The congenital type, which is probably due to some embryonic vascular disturbance in the neck of the femur is intimately associated with varying degrees of hypoplasia of the upper end of the femur. The mildest degree is by far the most common, and it comes on any time up to the age of four years, then steadily progressing until adult life is reached.

Roentgenograms of this type are characteristic, often being associated with a fissure in the middle of the neck of the femur. The appearance may vary from complete absence to complete development of the head and neck with and without a fissure. The missing upper femoral end may ossify to some extent, with growth. The fissure in the neck appears as a vertical, light area or as an inverted Y; or more rarely still, the neck may appear to be divided into several segments. The diaphyseal angle may be 90° or less. There may be other associated changes such as slight asymmetry of the pelvis, with slight decrease in the dimensions of that side, and the roof of the acetabulum may be more steep. The femur is often more slender; and the neck is shorter and convex upward.

The adolescent type occurs generally in the obese or pituitary type of individual. The incidence is most marked at the fourteenth year when the obesity is greatest. Adiposity and incidence diminish at the same rate until the nineteenth year when the disease has run its course and the patients are usually no longer adipose. There is considerable evidence that the pituitary gland plays an important part in this disease and that trauma is a minor factor.

In the roentgenogram of the adolescent type a slight displacement at or near the epiphyseal line is sometimes rather difficult to detect. The line described by Shenton is very helpful in this connection. In the normal case it is an unbroken arch formed by the top of the obturator foramen and the inner margin of the femoral neck. The line is constant no matter what the position of the leg, whether it be abduction, adduction, internal or external rotation. Roentgenograms will not distort it. However, many lesions of the hip, including coxa vara, will disturb this line. In coxa vara there is a displacement at the epiphysis or close to it, and the epiphysis in the earlier phases of the disease is somewhat broadened. The neck is convex superiorly and anteriorly, and the head is often semilunar in shape.

There is a diminution both of the diaphyseal and Alsberg's angle.

From 1912 to 1924, fifty-eight cases of adolescent coxa vara and 17 of the congenital type have been observed in the Mayo Clinic. The conditions were bilateral in 9 adolescent cases and in 3 of the congenital; unilateral affections are therefore the rule. Five illustrative cases are cited.

O'Sullivan, John. Some rarer intracranial calcifications and ossifications. *Brit. J. Radiol.*, 1925, xxx, 295–304.

Four groups of intracranial calcifications and ossifications are described. The first group comprises symmetrical retro-bregmatic ossifications of the dura. This is an unusual type of bony formation in the dura bordering the longitudinal sinus in the region of the vertex. This type of ossification has apparently not previously been described. Three cases are cited. The roentgenogram showed two symmetrically placed shadows in the region of the vertex corresponding in position and outline to the dura as it curves around to join the falx. Their sharply outlined and convex medial borders correspond to the walls of the longitudinal sinus. Their lateral margins are concave and rather indistinct. In contrast with the density of the shadows is the clear triangular lumen of the longitudinal sinus. The lateral view shows that the ossification is restricted to the retro-bregmatic portion of the sinus extending posteriorly from the bregma for a few centimeters and being separated from the inner surface of the skull by a clear space about 1 mm. wide.

The second group comprises calcified cysticercus. Two cases are described. The roentgenogram shows the inner surface of the calvaria to possess a slight degree of pressure markings and numerous broad deep venous grooves. In the center of the cranial cavity lie several dense, pea-sized, sharply defined shadows. In the postero-anterior view these shadows are approximately in the midline. The first case came to autopsy and the diagnosis was multiple calcified cysticerci in the arachnoid along the right side of the falx.

The third group comprise calculi in the brain. Three cases are reported, all showing the same type of calcification with approximately the same localization. The clinical features of the 3 cases were almost identical. Hemiplegia was present in all, associated with involuntary movements or epileptic attacks. In the first case the exact localization corresponds to the tegmen of the peduncle. In the others the site is the optic thalamus. In the first case there was a history of trauma at the age of three. In the second trauma probably occurred at birth, but in the third case no etiologic factor could be found. All these cases show the characteristic morphology described as typical of calcified scars in the brain. They are dense, sharply defined areas with, in places, spiky projections. Judging from a survey of the literature, the localization of the calcifications here described seems to be an uncommon one.

The fourth group consists of calcified tumors. A case is described in which the roentgenogram gave an unexpected finding. In the left frontal region there was a metallic splinter the size of a hemp seed. By means of roentgenograms taken in different directions this was found to be outside the skull. In addition to this there was a large calcification in the inferior posterior portion of the left cerebral hemisphere, consisting of an apparent fusion of multiple granular areas. Its configuration and disposition conformed with those of the posterior and inferior horns of the distended lateral ventricle. The calvaria as well as the skull base was of normal appearance. The clinical history and findings together with the roentgen examination lead to the conclusion that the small metallic splinter, the result of a war injury, was not responsible for the patient's headache and eye symptoms. The cause of the latter is furnished by the calcified tumor, probably a psammoma, in the posterior portion of the left lateral ventricle causing bilateral choked disc by general pressure and right sided homonymous hemianopia by local interference with the optic radiation.

Osgood, Robert B. The orthopaedic aspects of chronic arthritis. *J. Bone & Joint Surg.*, January, 1926, viii, 1–42.

Rheumatoid arthritis is a disease in which no specific organism has been found that can be held constantly responsible for its causation. Probably many different types of organisms and other factors play etiologic parts in the onset and course. Complete recovery is possible in the early stages of rheumatoid arthritis if the causative organisms and the other factors can be overcome. In the later stages, if the factors inimical to normal vitality can be eliminated and the essentials for normal body mechanics can be satisfied, arrest of the disease and great functional betterment may be expected. In this stage the simple eradication of a possible surgical focus of infection will rarely be successful in controlling the progress of the disease.

Osteoarthritis is a disease in which no specific organism has been conclusively proved to be responsible for its causation. Present

evidence indicates that its manifestations may occur unassociated with any demonstrable remote or local focus of infection. In the early stages of osteoarthritis, if a faulty body chemistry and a faulty body mechanics can be corrected and if intra-articular friction can be lessened, almost complete relief of the subjective symptoms is possible. In the later stages, if intelligent physiotherapy, protective appliances and well-conceived orthopedic surgery be added to these measures, relief of discomfort and gradually improved function may be expected.

The early roentgenogram in rheumatoid arthritis shows no discoverable cartilage or bone changes but there are present shadows of excess fluid and generally increased density of soft parts. In osteoarthritis the early roentgenogram shows an early slight "lipping" of articular margins; and shadows of localized synovial membrane proliferations may or may not be seen.

The late roentgenogram in rheumatoid arthritis shows diminished density of bone; usually absence of hyerpostosis; narrowed articular cartilage space; the ends of the bones fairly regular in outline; and usually bony ankylosis. The late roentgenogram in osteoarthritis shows no diminished density of the bones except after long disuse. There is present marked hyperostosis, "joint mice," narrowed articular cartilage space and irregularity in outline of the ends of the bones. Bony ankylosis is rare.

ROENTGEN AND RADIUM THERAPY

Skinner, E. H., and Lockwood, Ira H. The radiotherapy of goiter. *J. Missouri M. Ass.*, January, 1926. xxiii, 11–13.

Radiotherapy is the method of choice in toxic hyperplastic goiters with no pressure symptoms. On the other hand, radiotherapy is never indicated in a non-toxic rumor of the thyroid which produces pressure symptoms. If these two salient points be observed, the results of radiotherapy will establish confidence in the internist and abolish antagonism of those favoring surgery. Another type of goiter in which radiotherapy is indicated is the non-hypertrophic, toxic goiter with a high basal metabolism and representing a poor surgical risk.

Radiotherapy is a symptomatic treatment for hyperactivity of the thyroid; and the mere presence of an enlarged thyroid is not sufficient indication for radiotherapy. The dosage should be inversely proportional to the severity of the symptoms.

It seems generally agreed that roentgen rays, and sometimes radium, in the treatment of toxic goiters is the best leading remedy until it fails to relieve the subjective symptoms and to lower the basal metabolic rate. The comparative analysis of hundreds of cases treated by radiotherapy and thousands of cases reported from surgical clinics does not show any overwhelming advantage to surgery.

Staunig, K. Roentgen therapy of arthritis deformans. *Wien. klin. Wchnschr.*, May 21, 1925, xviii, 561.

Arthritis deformans appears to be a very satisfactory field for roentgen therapy. The affected joint is irradiated at intervals of seven days, exposures alternating between the anterior and posterior surface. The field is 20 by 20 cm. so that neighboring regions are also irradiated. The focal skin distance for the smaller joints of the extremities is 30 cm. and for the larger joints 40 cm. The dose administered is a superficial dose of 7 H. The radiation was filtered through 0.36 Zn plus 2 mm. Al, limiting wave length being 0.1 Å.

In one series of cases three doses were given and as a rule there occurred an amelioration of the symptoms and in many cases there was complete freedom from suffering. If there is no improvement after a first series of irradiations, a second series is given after an interval of six weeks. If this is without affect, a third series is administered after an interval of eight weeks.

About 400 cases have been treated up to now and the results have been very good. The swellings have gone down and the subjective symptoms have been diminished. Control roentgenograms disclosed no change in the appearance of the deformations. Occasionally one could see an increase in the structure in previously amorphous areas.

Stevens, J. Thompson. Toxic goiter: Its treatment by means of radium and the roentgen rays: Results controlled with basal metabolism tests. *Radiology*, January, 1926, vi, 7–13.

The diagnosis of hyperthyroidism or toxic goiter indicates at least a trial with radiation therapy: radium or roentgen rays alone or combined. Only very rarely will anything else be necessary, other than the indicated medical treatment, provided the administration be competent. Associated medical measures are very important no matter what the form of specific treatment.

Contraindicated for radiation therapy is the large tumor showing distinct signs of pressure. This should be treated surgically; later if toxicity still persists radiation therapy can be

added to perfect conditions. Those who fail to get relief after the proper application of radiation therapy should be referred for surgical treatment.

Radium is used in those patients who are unable to leave their beds because of severe toxicity. A sufficient number of tubes or needles of 10 mg. is used to cover the tumor. The application is in the form of a pack filtered by the needle wall plus 1 mm. brass, at a distance of 2 cm. The distance between tubes is 1 cm. The duration of exposure is up to 16 hours, depending on the individual case. When improvement warrants it, the patient is brought for treatment with roentgen rays because the latter are applied much more quickly.

To properly apply roentgen rays it is necessary not only to know the disease in question but to possess good judgement and detailed knowledge of the physics of radiation therapy. In general, the plan for roentgen treatment is as follows: A vertical line is drawn through the center of the thyroid isthmus and continued downward through the center of the sternum to the lower border of the thymus. Then a horizontal line is drawn above the thyroid gland extending to the distal edges of the gland. Here two more vertical lines are drawn downward. The rays are then applied in such a way that the central beam passes through the center of each lobe of the thyroid and downward and inward through the thymus region. The patient is then turned in the prone position and the rays are applied through two posterior ports exactly as was done when he was in the supine position. The factors are, 4 ma., 140 kv., 30 cm. distance and 6 mm. Al. In the very toxic this treatment, if properly applied, can be repeated in two weeks; otherwise an interval of four weeks is allowed. Thereafter treatment is repeated allowing increasing intervals or as indicated by the clinical condition and the basal metabolic rate.

Radium and roentgen rays will probably cure from 66 to 75 per cent of cases of toxic goiter. The results are at least equal to those obtained by any other method of treatment. Chronic abscesses or foci of infection should be eradicated in each case as soon as possible. Brief reports are given of 5 cases. In a series of 100 consecutive cases there is but one death from toxic goiter to report. However, the death was in no way due to the treatment but had been expected days before. Three patients treated by the author were subsequently operated on; one of these had not responded to irradiation and the author believes that the other two would have responded if the individuals had been a little more patient. These three cases did not receive postoperative irradiation and the end results of the surgical treatment are not completely satisfactory. Twenty-one more cases in the author's series of 100 consecutive cases did not complete treatment for one reason or another. This makes a total of 25 failures in the series of one hundred.

SZENES, ALFRED, AND PALUGYAY, JOSEF. The results of roentgen irradiation of the hypophyseal region in cases with symptoms of menopause. *Wien. klin. Wchnschr.*, May 7, 1925, xviii, 503–507.

Good results were largely obtained by the roentgen irradiation of the hypophyseal region in 38 cases with climacteric symptoms. In two to three weeks after the last irradiation the attacks disappeared completely in 8 cases (21 per cent), were very much reduced in number in 24 cases (63 per cent), remained uninfluenced in 3 cases (8 per cent) and were increased in 3 cases (8 per cent). A subsequent examination three months later in 25 of the cases disclosed in more than half of them a partial or complete recurrence as regards the number of attacks. The decrease in the number of attacks was twice as great after the third irradiation as after the first, and more than three times as great after the fifth. The profuse sweating occurring during the attacks in 24 of the cases disappeared or improved in 16, although only for about two months. In 4 cases which showed no profuse sweating before treatment, this symptom developed for a shorter or longer period after irradiation. Twenty-eight of the patients complained of headaches before the treatment, and in half of these cases roentgen irradiation gave more or less relief from this condition. Two cases previously without headache developed a headache after irradiation and in one case the headache was intensified after irradiation. The improvement in sleep was in general parallel with the decrease in the number of attacks.

On the basis of these results it is believed that the roentgen irradiation of the hypophyseal region may be recommended for the treatment of the symptoms of menopause. It must be emphasized, however, that careful dosage is necessary and accurate control of the symtoms is important because there appear to be certain cases which react to the roentgen treatments with an intensification of symptoms. Those cases which appear to be refractory after a third irradiation of the hypophysis should receive irradiation of the thyroid. Further irradiations of the hypophysis should not be administered until six to eight weeks after the last, and the dose should be smaller or else the therapy should be changed over to diathermy treatment of the hypophyseal region.

The roentgen rays were administered through a frontal or a parietal field, 4 by 4 cm., at a distance of 23 cm. from the focus. A Symmetrie apparatus was used with a Coolidge tube, 2 ma., 40 cm. parallel spark gap, filtered through 0.5 mm. Zn plus 4 mm. Al. The field received 50 per cent of the skin unit dose at each treatment. The second treatment was given a week after the first, the third fourteen days after the second, and the fourth and fifth each after a further fourteen-day period. Each treatment was given over a different skin area.

ULLMANN, K. Absolute and relative indications for roentgen therapy of dermatoses. *Wien. klin. Wchnschr.*, Apr. 30, 1925, xviii, 488–490.

This is a general survey of the therapeutic possibilities in dermatology. The field for application of roentgen rays is in the treatment of usually local, more or less sharply limited superficial processes in or immediately under the epidermis and lying somewhat deeper in glandular organs in or under the derma and in lymph glands. It also has application in such conditions as leucemia, lymphoderma, and mycosis fungoides. The third field or application is in the treatment of endocrine disturbances which produces symptoms in the skin.

There are certain conditions in which roentgentherapy is an absolute indication. These comprise skin diseases which are completely curable or incurable and inoperable. These diseases are listed as follows: acanthosis nigricans; actinomycosis; basal cell epithelioma; carcinoma (inoperable); corns; acquired, circumscribed hyperkeratoses in the hand and foot; Darier's disease; dermatosis papillaris capillitii (frambesi-formis); sycosis nuchae; favus; genital tuberculosis; leucemia cutis; chronic lichen; lupus vulgaris; lupus mucosae oris; lupus of the lip, anus, genitals; tuberculous and malignant lymphomas; mycosis fungoides; rhinoscleroma; scrofuloderma; sycosis vulgaris; trichophytosis.

There are dermatological conditions in which roentgen rays have a relative rather than absolute indication. Such diseases may be cured by other methods but there may be good reason for applying roentgen rays. The diseases listed under this head are as follows: acne vulgaris indurata; condyloma acuminatum; eczema seborrhoicum; epithelioma; folliculitis; diffuse keratoma; local hyperidrosis; keloid; lichen ruber sclerosus and spinulosus; chilblains; prurigo localis; psoriasis vulgaris; seborrheic exanthems; tuberculides; erythema induratum; lupus pernio; folliclis; lupus verrucosa; verrucae juveniles.

The general aspects of these conditions are briefly discussed from the standpoint of therapy, but the dosage and technique of roentgen therapy are not given.

VOGT, E. The relation of psychotherapy to roentgen therapy. *Strahlentherapie*, 1925, xx, 84–88.

From the large domain of the psychological relations of patients to roentgen therapy, the author selects for discussion as of particular interest to the roentgenologist, the psychotherapeutic problems involved in preparation of the patient for irradiation, in the administration of roentgen rays, and in after treatment. In recent years operative gynecology has begun to make systematic use of psychotherapy as an aid in treatment, and roentgen therapy might well do the same if it is to attain its highest ends. This is especially true for gynecological roentgenotherapy.

Psychotherapy has the task of properly preparing the woman for irradiation, carrying her through and making more tolerable the sequelae, such as roentgen sickness and climacteric symptoms. In the prophylaxis of roentgen sickness it is very important to prevent psychic infection by isolation before and after irradiation. The intensity of the climacteric symptoms following roentgen castration depends a good deal on the psychosexual constitution of the individual.

The best results will be obtained by that physician who has equal command of both roentgen therapy and psychotherapy.

VOORHOEVE, N. Malignant lymphogranulomatosis. *Acta radiol.*, 1925, iv, 567–589.

A critical review is given of the literature; and this is followed with the results of the roentgen treatment of 19 cases of far advanced malignant lymphogranuloma, the diagnosis having been confirmed histologically. It is stated that very much more favorable results can be obtained than is generally believed.

The great variety of forms assumed by the disease, its extent and the reaction of the organism make it necessary to individualize the treatment to a large extent. There are, however, certain general principles for a rational roentgen therapy: (1) the granulomatous tissue should receive a sufficient dose of roentgen rays. This involves the question of intensity; (2) The duration of the treatment should be dependent upon the extent of the disease; and (3) the therapy should be immediately reinstated upon the first appearance of a recurrence. Generally each portal receives an irradiation of 90 per cent of the erythema dose. One to two portals are exposed per day,

sometimes with an interval of several days. For very large portals and very great skin focal distances the dose per portal is given in two or three days. Local conditions should be kept in mind and suitable precautions taken to avoid injury.

Two to four weeks is required for a series, and about 70 per cent of the erythema dose is absorbed by the granulomatous tissue. A second series is often given three months after the first. As stated, the highly individualized treatment makes it impossible to give more details regarding the technique. As a rule, 160 to 200 kv. was employed and the rays were filtered through 0.5 mm. Zn plus 1 mm. Al.

The importance of treating each local affection with sufficiently large doses is particularly emphasized as well as treating recurrences as soon as they appear. It is important at the same time not to expose tissues remaining healed after treatment to more radiation than is absolutely necessary.

Attention is directed to several important points with regard to the treatment, as for example, the frequent occurrence of the disease in mediastinal and abdominal glands; the degree of leucopenia caused by the treatment, which may be quite marked without giving rise to permanent damage; the recognition of recurrences; the influence of the rays on the temperature, and its diagnostic significance; the circumstances unfavorable for the prognosis and the contraindications for treatment.

The importance of taking sections for histological examination is emphasized. Examination of post mortem material often shows that histological examinations during life do not in certain cases permit of a diagnosis of malignant lymphogranuloma.

WARD, GEORGE G., AND FARRAR, LILIAN K. P. The radium treatment of carcinoma uteri. *Am. J. Obst. & Gynec.*, April, 1926, xi, 439–449.

For purposes of comparative study, a standardized simple classification of the extent of the disease and the same rules for estimating end results and percentages should be adopted by all clinics. A monthly follow-up conducted in person by the surgeon in charge of the patient is of inestimable value as a factor in successful treatment. Schmitz's classification seems to recommend itself and has been adopted with slight modification in the clinic of the Women's Hospital, New York City.

In the radium treatment of carcinoma uteri details of technique are important. Especially should over-irradiation be avoided, and subsequent treatment should be based upon the reaction to the test dose of radium. Since it is important to take into consideration the effect of the first or test dose of radium (usually from 2400 to 3600 mg-hr.) it is not believed advantageous or logical to give a series of repeated treatments at short intervals as is done in some clinics. A sufficient time is required after the initial dose for the changes to take place in order that the character of the response may be judged. One case may require only a test dose to produce a satisfactory result; another may require several repeated doses at varying intervals, but not closer than six or eight weeks. In certain advanced cases the experience of the authors shows that three or more repeated irradiations have been of distinct value, and the results in general indicate that radium alone is preferable to surgery in all classes of carcinoma of the cervix. With the procedure followed by the authors, the results show 23.6 per cent patients living for five years or more. In those cases where the disease had not extended beyond the cervix, the end results show 52.9 per cent living five years or longer. This emphasizes the fact that at least 50 per cent of the early cases of carcinoma of the cervix can be saved by radium, and indicates the importance of educating the laity and the family physician to the necessity for early diagnosis.

While carcinoma of the fundus is best treated by surgery, the operative risk is often poor and resort may have to be had to radium and roentgen-ray therapy. Operation alone or radium and operation combined appears to give the best chance for a five year cure as judged from 52 cases seen by the authors. Large amounts of radium are not necessary to produce satisfactory results.

The value of roentgen-ray therapy in carcinoma of the uterus appears to be an undetermined question. The authors have employed moderate voltage roentgen therapy on a considerable number of cases as a post-radium treatment and the effects were far from beneficial in a large proportion of the patients. In some the results were positively harmful. Roentgen rays have therefore been abandoned for the present.

WASSINK, W. F., AND WASSINK-VAN RAAMSDONK, C, PH. The results of radiation treatment of skin carcinoma. *Acta radiol.*, 1925, iv, 146–156.

The final results of 160 cases of skin cancer treated by radiation during the period 1914 to 1922 are given. All the cases could be followed up and most of the survivors were examined by the authors personally. The treatment in most of the cases was with radium alone; a few received roentgen therapy alone

and the remainder received radium and roentgen therapy alone or combined, after excochleation.

There were 102 patients (63.75 per cent) still alive and free from recurrences in January, 1925. Up to this time 28 patients had been without local recurrence or metastases, from one to eight years after treatment. Therefore if we include these 28 cases the treatment can be considered successful in 130 patients (81.25 per cent).

Recurrences during the first one to eight years were seen in 25 patients (15.5 per cent), all of which with one exception could be cured by radium.

In 44 cases a previous attempt at radical cure by one or more operations, radiation treatment caustics or a combination of these, methods had iled before the patients were seen by the authors, and 27 cures could still be obtained amongst this group. Of the 116 cases not treated previously elsewhere, 104 (89 per cent) could be cured; 8 patients out of the 116 should be either considered as hopeless cases from the beginning or else they had died before results could be expected. In 4 out of 108 other cases the treatment was a failure. The failure in all the unsuccessful cases was due to unexpected extension of the tumor or to the impossibility of sufficient radium application or to the occurrence of secondary growths. There was not a single case where the authors were obliged to resort to surgical treatment.

Ulcers of about 4 cm. diameter usually received a single radium application from a capsule 25 mm. long, and 4 mm. thick containing 11 mg. radium filtered through 1 mm. brass, for about 20 hours. Roentgen therapy was employed only in the larger tumors and in certain carcinomas of the eyelids but here radium was used to completely remove tumor. In the case of tumors developing an external proliferation a sharp spoon was used to remove the superficial tumor tissue in order to aid in a uniform application of the radium. It is stated that the histological structure of the tumor was never considered in determining the treatment.

WERNER, P. On repeated irradiations in benign gynecological conditions. *Wien. klin. Wchnschr.*, Feb. 19, 1925, xviii, 217–219.

In the female clinic of the University of Vienna a good deal of experience has been obtained in the administration of roentgen rays for the treatment of benign gynecological conditions, where the object of the treatment was merely to reduce the intensity of menstruation or to induce a very temporary amenorrhea. There were 82 cases, most of whom received two treatments, many three treatments, and a few four treatments, at varying intervals. This group comprises cases in which there resulted an amenorrhea for at least two months after irradiation. They were cases of metrorrhagia or myoma, most of them occurring between the ages of twenty and forty years. In 64 of these cases, it was found that the second or subsequent irradiation took a considerably smaller dose than the first in order to produce the same effect; in the 18 cases in which the second treatments were as strong as the first, the result was almost invariably the production of a permanent amenorrhea. To produce a temporary amenorrhea for a second or a third time in an individual, about one-half to one-third of the first dose is sufficient. Usually the temporary amenorrhea after a second or a third irradiation lasts longer than that produced by the first irradiation. These observations seem to apply both to the cases of myoma and of metrorrhagia. It is emphasized that these characteristic effects are entirely independent of the age of the woman and are unrelated to the climacteric phenomenon.

WERNER, P. On the occurrence of malignant new growths in the female genitalia after deep roentgen therapy. *Wien. klin. Wchnschr.*, Apr. 9, 1925, xviii, 403–405.

A total of 2680 cases of myoma and nonmalignant hemorrhages received deep roentgen therapy in the female clinic of the University of Vienna between 1911 and 1924. An effort was made to follow these cases as long as possible after the treatment in order to determine the incidence of malignant tumors among them. There were found a total of 10 with malignancy, 2 doubtful. This gives an incidence of 0.3 per cent, which is far below the commonly accepted incidence of 5 per cent amongst gynecological cases.

This shows that gynecological deep roentgen therapy does not predispose to subsequent development of carcinomas, but rather tends in the other direction.

WETTERSTRAND, G. A. Roentgen therapy in surgical tuberculosis. *Acta radiol.*, 1925, iv, 528–540.

An account is given of experiments and results obtained in the roentgen treatment of surgical tuberculosis. Provided that the common precautions are not neglected roentgen therapy has, generally speaking, the same value as other methods now in use. In many cases, moreover, it possesses the advantage that it can be employed polyclinically—which is a great economic advantage. Small doses of roentgen rays are considered the best: about $\frac{1}{3}$ of a skin ery-

thema dose with an upward allowance of at most 50 per cent.

A considerable amount of the author's material consists of tuberculous lymphomas, with after-control in 234 cases. Difference in stage of the disease exerts but little influence on the result, but the period of treatment is prolonged by the spreading and fistulous forms. The radiations should be filtered through 3 mm. Al or possibly 0.25 mm. Cu, and there should be careful pre-treatment of the skin. No local irritations should be permitted during the whole period of treatment. There was relapses or possibly newly developed glands in 4 per cent of the cases; non-dangerous dermal changes in 12 per cent; and atrophy and telangiectasis in 3 per cent. No necrosis was noted.

The treatment of tuberculous peritonitis has proved extremely effective in cases where there have been no complications in the lungs or intestines. Cure was obtained in 15 cases out of 24, with an observation period of two to five years. There was transitory improvement in five cases, and 4 cases were not cured.

Tuberculosis of the female organs reacts extremely well to roentgen rays and this form of therapy is regarded as the best remedy at present. Out of ten cases 4 (hopeless when the treatment started) are now well; 3 have been free from symptoms for two years; 2 are still under treatment, although improved, and one case has disappeared. Cases operated on should receive subsequent roentgen therapy. Too little attention is paid to roentgen therapy in the treatment of tuberculosis of the male genital organs. The author treated 9 cases (8 of epididymitis and 1 of deferens relapse) and all have been restored to health.

Cases of fistulae after nephrectomy, tuberculous infected puncture canals and generally secondary nests of disease in soft tissues give a good prognosis. Roentgen treatment is also gaining a good position in the therapy of tuberculosis of the bones and joints.

Wirz, Franz. Roentgen treatment in syphilis. *Munchen. med. Wchnschr.*, Nov. 6, 1925, lxxii, 1910–1912.

During the past few years 4 cases of syphilis in women received a local roentgen treatment as a result of erroneous diagnosis. Two of the cases were of tertiary syphilis, one was of mixed primary and secondary and the fourth was of primary spyhilis. Three of the cases at first diagnosed as skin tuberculosis and the fourth one as lymphogranulomatosis. These cases had all undergone local roentgen treatments for a while before positive Wassermann reactions were observed. It was found that the cases with tertiary syphilis had become markedly resistant to specific antisyphilitic treatment. This resistance is ascribed to the local roentgen treatments which had in some manner weakened the tissues of the host. The other 2 cases showed a hypersensitiveness to salvarsan which made it very difficult to administer the specific treatment.

One of the striking observations was that the repeated roentgen treatments upon the local syphilitic areas did not cause any regression whatever; in other words, the primary lesion persisted much longer than is ordinarily the case, and infected glands developed to an extent that was unusual in ordinary syphilitic infections.

These effects may be interpreted as meaning that the roentgen rays produced a local tissue injury without in any way affecting the spirochetes. The injured cells were unable to react in the ordinary manner to the syphilitic virus and were moreover unable to take up the administered salvarsan. This interpretation would seem to indicate that a curative effect of roentgen rays depends entirely upon injury of certain cell and tissue functions. If this is so, then roentgen therapy is to a large extent merely symptomatic, and, just as with other symptomatic therapy, it can interfere with the process of recovery.

MISCELLANEOUS

Martland, Harrison S., Conlon, Philip, and Knef, Joseph P. Some unrecognized dangers in the use and handling of radioactive substances. *J. Am. M. Ass.*, Dec. 5, 1925, lxxxv, 1769–1776.

A report is given of a case of rapidly progressive anemia of the pernicious type with leucopenia and terminal infection in a woman aged thirty-five employed as a dial painter in a plant manufacturing luminous watch dials. From October, 1917 until 1923 the patient was in the habit of pointing brushes with her lips, but ceased this practice as the result of instructions issued at the factory in 1923. She was quite well then except for neurologic pains in the left leg. In 1924 these pains were so severe that a cane was necessary to assist in walking. In March, 1925, a condition simulating pyorrhea developed and the patient stopped work as a dial painter. She remained in fair health for three months and then gradually became weaker, the teeth became sore and the gums started to bleed. She developed an acute Vincent's angina and died within three weeks.

A second severe case is reported of local lesions with bone necrosis and chronic leucopenic anemia of the pernicious type in a woman aged twenty-four, still living, who had for

seven years been employed as a dial painter, and pointed brushes with her lips. The third case in a healthy individual is an example of exposure, with storage in the body of radioactive substances, but without apparent effect on the health. This was in a woman aged twenty-six who was employed as a dial painter and later became an instructor teaching others how to apply the paint. She always operated with very good brushes and did not pass the brush over the lips as often as other girls.

The cases above described represent a hitherto unrecognized form of occupational poisoning. The anemias encountered have been proven to be due to the ingestion of radioactive elements with deposition of insoluble fixed particles in the phagocytic cells of the sinusoids of the reticulo-endothelial system where they continually emit irritative radiations, and produce in time exhaustion of the adjacent hematopoietic centers. The necrosis of the jaw, which forms an important lesion in this disease, is due to local irritative irradiations at the portal of entry, produced by surrounding particles of radioactive substances and activated by increased bacterial activity in the mouth. There is a possibility that the bacteria are increased in virulence by exposure to small doses of radioactive rays.

In the present series of cases the radioactivity in the human body was demonstrated during life by means of electrometers. Tests for alpha radiation from normal tissues have been negative, whereas they were distinctly positive in the first of the above cases which came to autopsy.

The electroscope or electrometer is of very great clinical importance in demonstrating radioactivity in the expired air, since active deposits of radioactive elements can be detected in the body months and years before clinical symptoms appear. In a physicist who has handled large amounts of radium or mesothorium and who four years ago had had a severe anemia with loss of several teeth but is now in very good health, the authors have been able to demonstrate even four years after last contact with mesothorium a large amount of emanation in the expired air.

After radioactive elements are once deposited in the body there is no known way of eliminating, changing or neutralizing them. They diminish in amount only according to the individual characteristic decay. Radium takes 1750 years and mesothorium 6.7 years to lose one-half its original activity. The authors know of 5 deaths from such deposits in which the cause of death was variously attributed to sepsis, anemia, necrosis of the jaw, syphilis and Vincent's angina.

It would appear that the intravenous injections of long lived radioactive elements or the internal administration of them is highly dangerous on account of the late harmful effects. The supposed beneficial effects might only be countenanced in the treatment of leucemias, Hodgkin's disease, etc., in which the end is expected in a short time. This does not apply to use of short lived emanation. The value of radium waters is questionable.

An important etiologic factor has been established in the causes of obscure diseases of the blood. It is demonstrated now that a pernicious type of anemia may be produced by minute amounts of radioactive substances stored in and adjacent to the blood forming centers. A single lethal dose of radioactive material introduced into the body produces a destruction of local tissue and a generalized spontaneous anemia with leucopenia without a stimulative period. When small repeated doses are given there is a cumulative effect with or without local irritation at the point of entry. The general effect displays three successive stages: (1) period of stimulation with erythrocytes and leucocytes increased and patient in good health; (2) period of over-stimulation with erythrocytes and leucocytes still high, patient losing weight and developing bone pains and nerve pains, probably neuritis; (3) period of exhaustion with the body defence lowered and developing one of the three following clinical pictures: (*a*) rapid progressive leucopenic anemia of pernicious type; (*b*) chronic leucopenic anemia of the pernicious type with local infection; (*c*) chronic leucopenic anemia of pernicious type. All of these succumb to anemia or terminal infections.

Milani, Eugenio. Can roentgen cinematography become a current method of research? *Radiol. med.*, February, 1926, xiii, 129–130.

Two methods of roentgen cinematography, the direct and indirect have been tried, but as yet without very good results. The indirect method consists in taking with a cinematograph machine the image which is projected on the fluorescent screen. The direct method inaugurated by Groedel, has never become anything more than a laboratory method. A new method of indirect roentgen cinematography of the heart has been suggested to the author by recent research in television by means of which, in analogy with the telephone, pictures may be transmitted to a distance. Light vibrations which strike a selenium cell may, by the changes in electrical conductibility brought about, be transformed into electrical currents when the selenium cell is placed in an electrical circuit. Such currents

can easily be carried to a receiving curtain where the totality of the points will make up a picture.

Selenium has analogous properties with regard to roentgen rays and it is therefore theoretically possible for a screen of selenium cells, each cell of which is interposed in an electrical circuit, to transmit to a distance the image which falls on the screen, the individual pictures depending on whether or not a given cell is struck by the rays at successive instants, which will give a change in the form of the picture on the receiving curtain. Admitting the principle it remains only to work out the technique, on which the author is at present engaged, and he hopes that this suggestion may interest others in the work.

NEMENOW, M. On the theory of the biological action of roentgen rays. *Strahlentherapie*, 1925, XX, 299–306.

Roentgen rays cause the maturation or aging of cells, and the most radiosensitive cells are those that have advanced to a point near the end of their period. The age of the cell is considered to be determined by the relation between the period traversed and the whole life cycle.

In this connection the process of karyokinesis must be regarded as an expression of the aging of the cell. It appears that the nature of the biological process induced by roentgen rays which accelerates cell maturation probably consists in disturbance of metabolism associated with retention of the metabolic products.

PALUGYAY, JOSEF, Comparative studies on various chemical roentgen dosimeters and measuring tablets of different makes. *Strahlentherapie*, 1925, XX, 153–161.

The following three dosimeters were compared: (1) radiometer of Holzknecht; (2) the Cox chromo-radiometer, and (3) Hampson's roentgen-radiometer. All of these make use of the color change in barium platinocyanide caused by the roentgen rays.

Numerous comparisons were made and the results tabulated. The analysis shows that the coloration of the Holzknecht radiometer appears to be the most uniform. There is a certain amount of irregularity in the lighter portions as shown by the fact that the H units between 1 and 3 lie closer together than those between 4 and 6 H. In the Hampson radiometer the increase in color is gradual at first, increases quite considerably in the middle values, and slows down again at the maximum values between light and dark brown. The readings in the Cox chromo-radiometer are not made from a continuous band of increasing color but have to be read from 8 different colored glasses. In this case the variations in color tone are very different. Thus the colors A and $^1{}_5$ B lie close together. On the other hand, there is quite a considerable difference in shade between B and $1^1{}_5$ B, and between $1^1{}_5$ B and $1^2{}_5$ B.

Two other observers were asked to judge the ease of making readings with these dosimeters. The best agreement in readings was obtained with the Cox chromo-radiometer. Considerably better agreement was obtained in the readings of the Holzknecht radiometer over that of the Hampson radiometer.

For purposes of orientation the following factors are given. With a Symmetrie outfit and AEG-Coolidge tube, 228 to 231 volts, 5 amp., 2 ma., frequency 52, 23 cm. focal skin distance, field portal 6 × 8 cm., filter 0.5 mm. zinc plus 4.0 mm. alumimum, spark gap 40 cm., the erythema dose on the adult abdomen is $8^1{}_2$ H on the Holzknecht dosimeter, $^3{}_5$B on the Cox chromo-radiometer, and 3 on the Hampson radiometer.

The more detailed comparisons cannot be briefly abstracted.

PERONA, PIETRO. New automatic apparatus for roentgenoscopy and roentgenography. *Arch. di radiol., Naples*, September-October, 1925, i, 744–747.

Perona has previously described a method of roentgenoscopy in which it is possible to choose the best moment for taking a roentgenogram, thus avoiding the taking of useless roentgenograms. It necessitated a trained aid however for a single moment of uncertainty would lead to the closing of the current after the desired phase had passed. He now describes and illustrates an instrument which can be interposed in the current and which makes it possible for the roentgenologist to excute roentgenoscopy or roentgenography at will, by raising or lowering a handle which includes two resistances in the circuit or excludes them from it as desired. The instrument consists of a small table which is connected with the transformer of the generating apparatus and with the transformer of the Coolidge tube by means of a long flexible metal tube containing the connecting wires. On the top of the table there is a knife commutator which may be manipulated so as to include the table in the current so that the operator may perform roentgenoscopy or roentgenography, or so as to exclude it and allow the current to pass directly to the tube. In front of the interruptor are two linear rheostats one of which can be connected

with the apparatus generating the current and the other with the Coolidge transformer. At the right there is a hand commutator enclosed in a small metal case and provided with a handle which may be raised or lowered, including or excluding the rheostats, depending on whether roentgenoscopy or roentgenography is to be performed. On the front of the table there is a relay which charges automatically and which acts only when a roentgenogram is being taken. This eliminates one maneuver which would decrease the rapidity of taking a roentgenogram a little.

This apparatus can be used with an ordinary instrumentarium and has this advantage over Béclère's instrument which can be used only with his type of selector.

PIDONE, M. Changes in the fatty tissue around the breast following roentgen irradiation. *Arch. di radiol., Naples*, September-October, 1925, i, 738–740.

All the cases of necrosis of the adipose cellular tissue around the breast published heretofore have been due to trauma. The author reports such a case following roentgen treatment after operation for cancer of the breast. Postoperative irradiation was given over one large anterior field and two posterior ones and small supraclavicular fields. The dose was a full erythema dose with 38 cm. spark gap and three cycles of irradiation with intervals of 45 days between them. Two months after the last irradiation nodules the size of small nuts were noticed in the operation scar. They were thought to be recurrence of the cancer and a second operation was advised by one physician and radium therapy by another. The nodules were removed and found to be made up of degenerated fatty tissue with substitution of opaque granules for the fat in the cells. Around this necrotic zone there was reaction of the fatty tissue, with appearance of young connective tissue and polynuclear cells similar to giant cells. No trace of tumor cells. The vessels of the skin were affected with endarteritis and periarteritis. Le Cene thinks this necrosis is due to cellular ferments liberated by the trauma, especially those coming from destruction of leucocytes, which cause digestion of drops of neutral fat and transform them into fatty acids and insoluble soaps. But Pidone suggests that the necrosis may be due to vascular changes resulting in insufficient blood supply. At any rate it is important to know that this may occur after roentgen irradiation, as it may avoid a mistaken diagnosis of recurrence and renewed operation or radium treatment, which would undoubtedly have been harmful in this case.

PIETTE, EUGENE C. Necropsy of a roentgenologist. *Radiology*, December, 1925, v, 525–526.

Dr. S. P. Grigorjev, a Russian roentgenologist, died at the age of forty-six, from typhoid fever. The course of this typhoid was unusual in that there were three successive relapses, a condition corresponding to the findings on post mortem examination.

The interesting post mortem features of this rare case of the effects of roentgen rays of twenty years' duration are as follows: The dorsal surfaces of the hands present the classical picture of roentgen dermatitis—the skin is hard, rough, stiff and cannot be folded. There are many warty spots, some ulcerated. The most pronounced changes are seen on the fingers, where the sclerosis and ulcerations are particularly extensive and deep. There are only five fingers remaining on the two hands, the others having been previously amputated because of painful roentgen dermatitis. There is no hair on the dorsal surfaces of the hands and fingers. The nails are tumefied and opaque, of brownish or yellowish color, and irregular surface. On opening the skull, the dura mater is found to be firmly adherent on almost all surfaces to the bones. The vessels of the pia are injected. The arteries at the base of the brain are sclerotic in some places. Both lungs are fixed by recent adhesions to the chest wall. The parenchyma is flooded by edematous fluid; many bronchopneumonic foci are seen. The aorta and coronary heart vessels are sclerotic.

Near the ileocecal valve an ulcerated Peyer's patch is present. Two more ulcers in a state of desquamation are located higher up. Still higher, two more patches are visible, being in a state of tumefaction. This simultaneous presence of different phases of typhoid evolution of Peyer's patches explains the clinical picture—three successive attacks of fever. The lymphatic glands all over the body appear atrophic, showing no traces of the mobilization usual in typhoid fever.

Microscopic examination of the ulcerations on the skin reveals the typical picture of roentgen dermatitis. The epithelium is greatly thickened near the ulcers, and its papillae elongated, penetrating into the underlying tissues. The dermis is sclerotic and richly infiltrated with numerous plasma cells and polyblasts. Subcutaneous vessels show but a slight swelling of the epithelium.

The structure of the lymph glands is greatly changed. There are no proliferating structures seen; the quantity of lymphocytes is far below normal. The reticular tissue meshes are filled with numerous large, rounded or irregular

cells in addition to lymphocytes, which contain in some places two nuclei. These cells are probably of reticular origin. The same elements are present also in the atrophic white pulp of the spleen, where the lymphatic tissue is markedly decreased.

The changes in the testes are pronounced. The wall of the seminal tubes is thickened and hyaline, and the lumen is obliterated in most places. Where the lumen is preserved, only a few Sertoli cells are found within. All the spermatogenic elements are absent. Among the tubes numerous groups of interstitial cells are located, containing no crystalloids.

The following findings can be attributed to the chronic exposure to roentgen rays on the human organism: Ulcerative roentgen dermatitis, general atrophy of the lymphatic tissue (which probably has fatal significance in this case), irritation of the reticulo-endothelial system, degenerative changes in the reproductive system (which has no depressing influence on the mental or creative forces), diffuse arteriosclerosis of the large vessels, particularly in the brain and heart, and finally, obliterative pachymeningitis.

RAHM, HANS. Late roentgen injuries. *Strahlentherapie*, 1925, XX, 213–214.

Over 2100 intensive deep therapy treatments were given in the Surgical Clinic of the University of Breslau between 1919 and 1922, and 12 cases developed late roentgen injuries, i.e., little over 0.5 per cent. This average is considered not to be excessive for that particular period in the development of roentgen therapy. The dose applied was usually less than 100 per cent of the average skin erythema dose (about 600 R). The cumulative effect upon the subcutaneous tissues was not fully appreciated at that time and this accounts for the injuries observed.

ROSENAU, W. H. Dangers in the use of certain halogenated phthaleins as functional tests. *J. Am. M. Ass.*, Dec. 26, 1925, LXXXV, 2017–2020.

The toxicity of the halogenated phthalein compounds should lead to caution in their use. Indiciminate administration and overdose should be avoided. Following the use of phenoltetrachlorphthalein thromboses, local inflammatory reactions at the site of injection and chills have been encountered by many observers. Several deaths probably due to its use have been reported. Clinical and experimental work indicates the possibility of strain or damage to the liver following injection of the dye.

Attempts were made to render phenoltetrachlorphthalein non-irritating on injection by the use of the following solvents: (1) distilled water; (2) physiological saline; (3) 5 per cent sodium bicarbonate; (4) 5 per cent sodium carbonate; (5) phosphate buffer solution. These attempts were unsuccessful.

Many observers have noticed severe toxic reactions following the use of tetrabromphenolphthalein and tetraiodophenolphthalein. It would appear that the bromine and iodine phthalein compounds used in cholecystography possess to a greater or lesser degree the irritating and toxic properties of the chlor compound.

SCHREUS, H. TH. The position of roentgenology in medicine and law and the necessity for the development of special attention to it in the universities. *Strahlentherapie*, 1925, XX, 432–440.

Recent statistics show that only five of the twenty-three universities in Germany have instructors exclusively for roentgenology. This situation is deplored in the light of the growing conviction that roentgenology is an important special field and should be adequately taught.

Roentgen diagnosis is an important but not entirely independent aspect of various departments of medicine. On the other hand, roentgen therapy has developed as a definite, special field employing its own methods and based upon fundamental physical and biological foundations. We find in some of the German universities roentgenology represented only as divisions of the different clinics without being supervised by an expert roentgenologist. In others, there is, in addition to the above, an independent physical roentgen research institute or a special institute attached to a clinic and supervised by a university instructor. In other universities the diagnosite facilities are divided among the special clinics and the section on roentgen therapy is centralized under the direction of a roentgenologist. There are others, like the one at Hamburg, where all the facilities are placed under one central roentgen institute.

In such countries as Roumania, Russia and Sweden instruction in roentgenology is now obligatory upon medical students. It is recommended that no student should be graduated who is unable to prove a knowledge of the fundamentals of roentgenology, and the theoretical aspects of the methods; and further, that he has used them practically, and that he has an idea of the dangers and of the methods for preventing them. The time is considered ripe now for making roentgenology a subject for state examination for license.

It is suggested that the following proposition be established so far as possible, namely, that no one shall be recognized as roentgenologist (specialist) who has not studied the subject as a medical student, and furthermore the state should not permit any physician to install a roentgen apparatus if he is unable to prove that he had mastered at least the elementary essentials of the subject as a student.

SCHREUS, H. TH., and BERGERHOFF, W. Total irradiation or partial irradiation of flat surfaces? *Strahlentherapie*, 1925, XX, 378–388.

Holzknecht in 1904 laid down the principles governing the production of uniform irradiation upon flat surfaces. He found that a reasonably uniform exposure was given when the focal skin distance was twice the diameter of the skin area to be exposed. When two or more adjacent fields are to receive irradiation there is a certain amount of overlapping, and the areas in which overlapping occurs will receive considerably higher doses than intended. Attention is directed to the fact that the Holzknecht rule applies only to unprotected tubes. Where the tube is entirely covered (except for a small portal) in the irradiation of two or more adjacent skin areas, the zone of overlapping will receive a surface energy of 152 per cent, as compared with 100 per cent for the center of each field. This applies to skin therapy apparatus having a portal of 8.5 cm. diameter and situated 9 cm. from the tube focus and acting upon a circular area 24 cm. wide at a focal skin distance of 25 cm. Attempts to minimize the effect in the zone of overlapping by changing the focal skin distance showed no satisfactory combination.

Consideration of all these factors indicates that the total irradiation of extensive surfaces from several positions of the tube cannot be satisfactorily accomplished and the only recourse is to make use of partial irradiations. Measurements of the surface dose with the Fürstenau intensimeter shows a 100 per cent dose in the center and 93 per cent dose at the periphery of a circular field 25 cm. wide with the tube focus 30 cm. distant. This is considered reasonably uniform for practical purposes. The authors' plan is to expose areas 20 × 20 cm. in succession until the whole surface is covered, care being taken to screen off all the surface except the single zone being treated. The same effect can be obtained when the funnel from the roentgen tube is so adjusted as to prevent overlapping of fields. The latter procedure is now in common practice and should not be called total irradiation but rather partial irradiation.

SCHWARZ, GOTTWALD. The biology of irradiated tumors. *Strahlentherapie*, 1925, XX, 67–83.

During the healing of a roentgen irradiated basal cell carcinoma there can be observed macroscopically proliferations of the cornifying flat epithelium, which, although resembling the histological picture of a cornifying cancer, are actually only reparative processes. Microscopically the necrobioses after roentgen irradiation of histologically quite similarly constituted basal cell carcinomas are individually quite different. A case of basal cell carcinoma in a woman, aged eighty, was studied histologically to see how far the occurrence of so-called "crumb" mitoses, which had been previously studied by Politzer-Alberti in the cornea of the salamander embryo, could be applied to human carcinoma.

The primary effect, according to Alberti-Politzer is a clumping of the chromatic bundles, pseudo-amitosis, with a rapid decrease in the number of mitoses. This could not be confirmed in the basal cell carcinoma under observation. The patient received a dose of 8 Holzknecht units at each of three treatments, given twenty-four hours apart. The presence of a mitosis-free intervening stage could not be demonstrated after any of the individual doses administered. Three days after the first dose, two days after the second and one day after the third, there occurred a rapidly accelerating increase in the mitosis, far beyond the original number, and assuming exclusively the forms of the "crumb" mitosis with clump dissemination and agglutination, corresponding to the secondary effect described by Politzer-Alberti. This aggregation of chromatin is due to a slowing down of the course of karyokinesis and of the cessation of new nucleus formation. The cells break down during the mitosis so that the chromatin fragments are set free in the extracellular space. The accumulation of these mitotic fragments continued for about four days at about the same level, and then sank rapidly and was followed by a practically mitosis-free period during which the tumor regressed to complete healing.

In the treatment of similarly reacting tumors with a divided dose administered on two or three successive days, there is no danger of producing that practically amitotic state regarded by Alberti-Politzer as unfavorable, in the sense of intensifying the effect to too great a degree. In the roentgen irradiated tumors whose activity of cell division is not completely destroyed we find the formation of mitotic fragments in unusual numbers so that we may regard their occurrence as a sign of the activity of the rays.

Stoklasa, Julius. On the effect of radioactivity upon the energy and metabolic processes in the animal and plant cell. *Strahlentherapie*, 1925, xx, 186–196.

It has been found that radioactivity exerts an extraordinary stimulus upon the micro- and macro-flora of the soil. Soils composed of material of volcanic origin possess a much greater radioactivity than those from sedimentary deposits. The agricultural conditions in the Joachimsthal and in the vicinity of Vesuvius are cited as confirming this opinion. It is claimed that the radioactivity induces oxidative processes and stimulates sexual processes not only in plants but in the animal kingdom. The author believes that the fecundity of the inhabitants of the Italian Campania is undoubtedly due to the radioactivity of their air, soil and food.

In the respiratory processes of animals and man, radioactivity has been found to exercise an important function. The primary process is an enhanced intracellular respiration induced by beta rays. The activity of glycolytic enzymes is stimulated and the first product formed is lactic acid from which is produced carbonic acid, acetaldehyde, alcohol and acetic acid. These particular changes are induced by animal zymase and lactacidase.

Experiments show that in the presence of radium emanation with complete exclusion of oxygen, alcohol is oxidized in intracellular respiration to acetaldehyde, acetic acid and CO_2. Radioactivity greatly stimulates the oxidations of alcohol and acetic acid, a fact which deserves attention since this is a normal breakdown process of the carbohydrates in the human organism.

Experiments have shown that alpha rays greatly stimulate the respiration of cells with or without chlorophyll. A concentration of 26 to 83 Mache units is capable of increasing the CO_2 production by 40 to 90 per cent. It has also been shown that strongly radioactive baths taken in conjunction with a liberal supply of oxygen is able to increase the whole enzymic activity in the human; and alpha rays and oxygen increase the respiratory metabolism. It is claimed that agricultural production can be increased up to 100 per cent by the use of beta rays.

Zacheri, H. The influence of irradiation on the Philipp virulence test in collum carcinoma. *Strahlentherapie*, 1925, xx, 57–66.

The Philipp virulence test is a test of the degree of virulence of septic organisms in an infected individual. The test depends in principle on the effect of the individuals' blood upon the growth of the particular organisms. An examination of 6 operable and 33 inoperable cases of collum carcinoma showed in 43.5 per cent of the cases the presence of virulent organisms. In all those cases where avirulent organisms were present there was no development of fever after operation, while in cases showing virulent hemolytic streptococci or hemolytic staphylococci, a number showed a high fever of long duration, with severe complications. The experience with the Philipp test indicates its value in determining the virulence of contaminating bacteria; and a positive test is regarded as a sign of increased danger for the patient and indicates a conservative treatment.

It therefore appeared important to find some means of reducing the virulence of organisms in positive cases in order to improve the prospects of the patient. It was observed that a definitely positive virulence test in a woman with collum carcinoma became distinctly negative fourteen days after a treatment with radium. The ulcerated area became entirely clear, and there was no radium scar. This experiment has since been repeated in 9 other women with the same result; and it has also been observed in one case after a roentgen irradiation of carcinoma with the carinoma dose of Seitz and Wintz. A negative result has been obtained in only one case treated with radium.

The author believes that the reduction in virulence and disinfection of the infected area was due to the applied radiations. This effect is obtained only when highly filtered, hard rays are administered.

Zwaardemaker, H. The microradioactivity of animal organs and its physiological significance. *Strahlentherapie*, 1925, xx, 215–231.

There is an undoubted radioactivity in normal tissue. Becquerel failed to disclose this property despite repeated experiments, but W. E. Ringer by using especially designed apparatus, found in ashed tissue, definite evidence of beta ray activity, probably due to potassium radioactivity.

The author has demonstrated that automatic organs like the heart, esophagus, intestine, and uterus may be made to lose their muscular activity by washing them free of their potassium content. The normal activity is apparently restored not only by restoration of the potassium in the perfusing fluid but by substitution of other radioactive elements such as uranium, thorium, ionium, radium and radon. These substitutes for potassium are so diverse in chemical nature that it is hard to conceive the restoration of tissue activity to be due to any of the usual chemical properties

of these elements. The only factor common to all of them is their radioactivity, and their ability to activate the tissues is approximately in proportion to their radioactivity. The average doses used in the case of the frog heart in milligrams per liter of perfusing fluid were: potassium chloride 100; thorium nitrate 50; uranyl nitrate 25; radium salt 3×10^{-6}; radon 0.01 microcuries. Both alpha and beta ray sources are able to replace the potassium.

Attention is directed to the fact that the quantities of radioactivity represented are very small indeed. Experiments show that larger doses exert an injurious effect on function. It would seem that nature accomplishes its purpose under physiological conditions with vanishingly small amounts of radiant energy; that is, with a far smaller number of emissions than can be accomplished by artificial means.

It is concluded that the microradioactivity of animal organs lies at the limit of physical measurement. Since the normal potassium of physiological fluids can be replaced with other radioactive elements in radio-equivalent amounts, we have a biological method for demonstrating the existence of bioradioactivity.

HARRENSTEIN, R. J. On roentgenological orientation with reference to the hip joint in the child. *Acta radiol.*, 1925, iv, 357–362.

A roentgenological investigation was made of the situation of the Y-furrow in the pelvis of children. A comparison was made of the positions of the socket of the hip joint and of the Y-furrow, each of these structures being filled with barium vaseline; and it was found that the furrow changed its direction with increasing age. The current view is that this furrow is situated in the pelvis in such a way that on the lengthening of this fissure the socket of the hip bone becomes divided into two equal parts. This view must be modified both for the normally and the abnormally developed hip joint.

In the case of the normal hip joint, the socket of the hip bone in the newborn child is divided into two equal parts on the roentgen picture only through the line of direction of the Y-furrow. As the age of the child increases the direction of the furrow changes so that the division of the socket now results in an upper part which is constantly becoming smaller and a lower part which is constantly becoming larger. In forming an opinion as to the state of the head of the femur after reposition of a congenital dislocation of the hip, it is necessary to break with the old view that the line of direction of the Y-furrow divides the head of the femur in half. In the majority of cases the greater portion of the bone lies beneath this line.

HAUPT, WALTHER, and OBLADEN, PAUL. A filter safety device for the Siemens irradiation chamber. *Strahlentherapie*, 1925, xx, 651–654.

A description is given of an automatic device intended to prevent exposure to roentgen rays unless a filter has been inserted in place.

The outlet end of the Siemens chamber has a frame, half of which is lead covered and the other half open. The device is such as to lock the frame with the lead in place and this lock cannot be released except by the introduction of a filter.

HAXTHAUSEN, H. Invisible changes in the *x*-radiated skin. An experimental study. *Acta radiol.*, 1925, iv, 499–506.

The observation has frequently been made that recurrences in roentgen treated eczemas are often very obstinate and sensitive. This has raised the question whether the normal skin after roentgen irradiation becomes less resistant to external irritations, and experiments were performed by the author to determine the effects. The experiments were carried out with patients suffering with goiter, or Basedow's disease. Three circular areas on the neck and the upper part of the chest were irradiated from one to twelve times with one Sabouraud unit through 4 mm. Al, with intervals of one to two months between treatments. Except for a slight pigmentation in some of the cases there were found no visible roentgenological changes in the skin. In 28 cases there was produced, with the help of the mercury quartz lamp, a light erythema on the roentgen-rayed fields and a suitable area of the surrounding skin. This erythema was uniform over the whole skin in 13 cases; it was stronger on the roentgen-rayed portion of the skin in 14 cases and it was weaker in only one case.

In 32 cases dermatitis was caused by rubbing into the skin a 5 per cent croton oil ointment. There was no difference between the roentgen-rayed and the normal skin in 19 of these cases; and the dermatitis was greatest in the roentgen-rayed fields in 13 cases.

No certain relation can be shown between the intensity of the roentgen treatment and a positive reaction in the experiment. It is, however, clear that the roentgen irradiated skin reacts in a large number of cases more strongly than normal skin to external irritations and this takes place even though the roentgen-ray dose is kept within the limits of eczema therapy, and there are produced no direct visible changes in the skin.

Holzknecht, G. Is there an indirect stimulative effect of roentgen rays? *Wien. med. Wchnschr.*, Jan. 17, 1925, lxxv, 161–163.

Roentgen rays have their essential therapeutic effects just like other medicaments. These effects are primary and secondary. The primary action is evident when tumors, for instance, are directly destroyed or unhealthy hair is temporarily injured. The immediate cell injuries produce indirect sub-effects during the course of life processes; these are the secondary effects which are not so well understood, as for instance, the destruction of leucocytes with the liberation of the antitoxins within them, and such like.

The author believes that the term "stimulative effect of roentgen rays" has no place in the realm of fact, in theory, or in our scientific nomenclature. It is customary to speak of this stimulative action as an explanation of those roentgen effects which we do not yet understand; but one thing is certain, the primary effect of the roentgen rays is the production of an injury of greater or less extent upon the irradiated area.

Holtzknecht, G., and Pordes, F. Recognition of the nature of the roentgen-ray effect. *Strahlentherapie*, 1925, xx, 555–564.

Inspection of roentgenological literature of 1920 discloses the dominance of the belief that roentgen rays are capable of exercising a direct stimulative action in the living cell. This opinion was based on the so-called Arndt-Schulz "law." As a matter of fact, this is not a biological law but rather a rule useful in certain cases, but it is by no means reliable. There was no experimental evidence to show that roentgen rays did exert a stimulative action, but faith in the operation of this "law" led to the belief that such a stimulative action must exist.

An analysis of the fundamental facts by Holzknecht, Pordes and others led to a denial of the operation of the Arndt-Schulz "law" and led to the development of the theory that the primary action of roentgen rays is a depressive or destructive one. All the known experimental facts fit in with this theory.

The physical nature of roentgen rays is quite well understood but there are a number of important gaps in our understanding of the effects of these rays upon living matter. There is now a considerable body of experimental evidence as to the immediate effect of the rays upon cells. An important gap in our knowledge is the manner in which the radiation produces these so-called primary histological effects. Is it, as Dessauer believes, the transformation to thermal energy, or is it some subatomic phenomenon whereby the incident radiation exercises a trigger effect that sets in motion the pathological response?

We know in addition, in reasonable detail, many of the clinical effects resulting from roentgen irradiation. What occurs between the primary effect and the clinical effect constitutes another important gap in our knowledge. It is quite probable that the roentgen effect is not confined to a single cell group or organ and it may be that there are reciprocal effects in many of the cells and organs which will have to be taken into consideration before a satisfactory answer to the problem can be vouchsafed.

The authors stress the value of some guiding hypothesis or hypotheses such as the above in aiding the progress of roentgenology. The hypotheses are, however, useful as long as they give a reasonable understanding of the processes and stimulate the extension of scientific thought.

Hussey, Raymond G., and Thompson, William R. The effect of radioactive radiations and *x*-rays on enzymes. IV. The effect of radiations from radium emanation on solutions of invertase. *J. General Physiol.*, Nov. 20, 1925, ix, 211–215.

Beta and gamma rays from radium emanation in equilibrium with its radioactive products have the power of inactivating trypsin and pepsin in solution. The course of the radiochemical reactions can be followed quantitatively; and under the conditions of experiment employed it was found that the change in the logarithm of the concentration of active enzyme is a linear function of the product of two variables, namely, the average activity of the radioactive source, and the time of exposure.

The above observations with respect to trypsin and pepsin have now been extended to another enzyme, invertase, and the same relations have been found to hold.

Jerman, E. C. An analysis of the end-result: The radiograph. *Radiology*, January, 1926, vi, 59–62.

Assuming the selection of a clean film free from fog, of proper screens free from blemishes and of proper dark room procedure, there remain four factors which contribute to the quality of the end result: the roentgenogram. These are distortion, detail, contrast and roentgenographic density. A thorough understanding of the various methods that control these four factors will contribute much toward the control of the quality of the product.

Distortion is controlled by the distance of the object from the film, the distance of the focal spot from the film and alignment of focal spot, object and film. Detail is controlled by distance of object from the film, distance of the focal spot from the film, alignment of the focal spot, object, and film, use or non-use of intensifying screens, screen-film contact, secondary radiation, and size of focal spot.

Contrast is controlled by time of exposure, use or non-use of intensifying screens, secondary radiation, and occasionally milliamperage. Roentgenographic density is controlled by time of exposure, gap or voltage, and time of development.

Jordan, Sara M. Basal metabolic rates and their relation to end-results in thyroid disease. *Arch. Surg.*, July, 1925, xi, 1–17.

The determination of the basal metabolic rate is of undoubted value in a clinic for thyroid disease; (1) to differentiate between hyperthyroidism and other conditions simulating this disease, especially neuro-circulatory asthenia; (2) to differentiate between tumors of the thyroid with hyperthroidism and those without it; (3) to aid in the estimation of the severity of the disease in both primary and secondary hyperthyroidism, thereby procuring definitely helpful data in a decision for operative procedures throughout the treatment; (4) to estimate the adequacy of surgical treatment and the necessity for further treatment when the usual procedure has been inadequate; (5) to guide the treatment of myxedema.

A statistical study is presented of the results from the basal metabolism laboratory of the Lahey Clinic, Boston. The material comprises the results of 5,200 consecutive tests in 1,675 patients; 1,258 of these patients were operated on in the Clinic with the following diagnoses; primary hyperthyroidism, 553 cases; adenomas with secondary hyperthyroidism, 320 cases; benign tumors of thyroid without hyperthyroidism, 390 cases; and malignancy of thyroid, 15 cases. In the clinical group of primary hyperthyroidism all but 9 of the 533 cases showed an increased basal metabolism.

The pre-operative basal metabolic rate in primary hyperthyroidism was in 64.6 per cent of the cases above plus 50. The pre-operative basal metabolic rate in secondary hyperthyroidism in 24.5 per cent of the cases was above plus 50. The multiple stage operation was practiced in primary hyperthyroidism in 62 per cent of the cases. In secondary hyperthyroidism only 7.8 per cent had a multiple stage operation. The relation of the number of stages to the pre-operative height of basal metabolic rate is much more definite in primary hyperthyroidism than in secondary.

In the primary hyperthyroidism series 6.7 per cent failed to show a normal rate after six months. In the secondary hyperthyroidism group only 1.9 per cent failed to reach normal in six months. Re-operation for recurrences or for persistence of hyperthyroidism occurred in 2.4 per cent of the primary hyperthyroidism cases and in only 0.9 per cent of the secondary cases.

Diabetes mellitus occurred in 2.6 per cent of the primary hyperthyroidism group and in 1.5 per cent of the secondary group. Postoperative myxedema occurred in 0.9 per cent of both the primary and secondary hyperthyroidism cases. The mortality in primary hyperthyroidism was 1.7 per cent and in secondary hyperthyroidism was 1.2 per cent.

The clinical results of the surgical treatment are consistently indicated by the changes in the metabolic rate.

Kahl, Hermann. The horizontal position of the stomach. *Fortschr. a. d. Geb. d. Röentgenstrahlen*, 1925, xxxiii, 713–716.

The shape of the stomach is conditioned by the tonus and the peristaltic function. Both these factors cause the stomach to assume, for purposes of optimal function, the characteristic siphon shape. The shape of the gastric contents which vary for different positions of the body according to physical laws. The elimination of the factors of hydrostatic pressure, according to Goetze, causes the stomach to assume its natural retort shape when the human body lies supine with the head end lifted to an angle of 30°. This arrangement gives a natural shape of the stomach in the dorsoventral roentgenogram. The caudal pole of the stomach is somewhat raised and the gastric bubble is absent. No portion of the stomach seems to be under strain and no distortions are evident.

The author points out that there are numerous individual variations which affect the shape of the stomach and that the only real effect produced by the conditions described by Goetze is the placement of the pylorus-cardia axis in a level plane. The stomach itself still maintains its hook shape and the hydrostatic pressure merely affects another portion of the organ. Examples are sketched of (1) a normotonic stomach; (2) and (3) different degrees of atony, and (4) cholecystitis with slightly fixed pylorus, and medium hypertonicity. The frontal pictures taken under exactly similar conditions show that the stomach does not assume the same form in all cases,

owing to the fact that the hydrostatic pressure exerts a different effect in each instance. It is concluded, therefore, that it is impossible to secure a horizontal position of the stomach and at the same time eliminate the hydrostatic pressure.

KALKBRENNER, H., AND KÜSTNER, H. Studies on roentgen dosimeters. *Beitr. z. klin. Chir.*, 1925, CXXXV, 303–324.

A thorough comparison was made of the Martius ionimeter, the iontoquantimeter and the Wulf ionimeter. Using 2 ma. and a 50 cm. focal distance upon a free ionization chamber, it was found that all the customary roentgen beams utilized in deep therapy produce a true saturation current for all portions of the iontoquantimeter scale and from 30 to 50 on the Martiss ionimeter. In the case of the Wulf ionimeter the same factors barely produced saturation within the 10 scale divisions of the instrument. It appears necessary therefore to reduce the voltage sensitivity of the latter instrument. The studies have shown that, other conditions being equal, saturation will always be produced with soft radiations if it has been attained with the harder rays, but not vice versa. For this reason there is greater danger that incomplete saturation will give an indication of excessive values for the depth dose. Whenever it is necessary to test an instrument for saturation with a single mixture of rays, this should be done with the hardest mixture.

The amber insulators and neighboring spaces in the iontoquantimeter and in the Wulf ionimeter are inadequately protected from the rays, with the result that the former shows a 65 per cent and the latter 190 per cent greater ionization under the very hardest rays as compared with softer; consequently, these devices should be shielded with a 5 mm. lead screen to cover the brass portions and the insulators. The industry should make efforts to correct these difficulties and also furnish better protection to the cable. These various sources of error may in certain cases occasion as much as 100 per cent error in the dose.

The thimble ionization chambers should show no effect of direction of the beam; but examination disclosed that axial radiation with very hard rays on the iontoquantimeter gave 9.2 times greater ionization effect than that produced by perpendicular irradiation, and in the case of the Wulf ionimeter the factor was 12.7. This disturbing effect decreases with the time of irradiation. To what extent this error affects the determination of depth doses remains to be determined.

In addition to the directional effect due to inadequate lead protection, there is still another of opposite effect caused by the shape and material of the chamber. A cylindrical chamber shows a minimum of ionization when irradiated parallel to its axis, and a maximum when irradiated perpendicularly. The effect is greater with a copper chamber, less with an aluminum chamber and least with the graphitized paper chamber. It is obvious therefore that the error may be considerably reduced by utilizing a spherical chamber made of graphitized paper.

Calibration curves in terms of R, very carefully made, show a pronounced dependence upon the wave length in the case of aluminum chambers, and a very slight one with the carbon chambers. The superiority of the carbon chamber from the standpoint of general practice seems to be established by these observations.

KLEIN, EUGENE. Gastric motility. 1. The origin and character of gastric peristalsis. *Arch. Surg.*, February, 1926, xii, 571–582.

There is both anatomic and experimental evidence for the belief that the gastric wave originates in a nodal center on the lesser curvature at the cardia. There are two main types of gastric waves: (*a*) the type usually seen roentgenoscopically, in which the wave progresses uninterruptedly from its origin to the pylorus as a peristaltic wave; and (*b*) the type in which the wave passes downward as a peristaltic wave from its origin to the reentrant angle, to be followed by a concentric contraction of the antrum as a whole. These waves have been described in dogs, cats, rabbits, and man.

Variations occur within these types of waves the chief being the following: (*a*) the wave passes down over the body reaching the angle and terminating there, with no antral activity following; (*b*) antral waves may start at the angle and pass to the pylorus as independent waves and may not follow visible waves coming down from above. Retrograde waves may start at the pylorus and run back over the antrum. The presence of a solid body in the antrum may initiate these retrograde waves.

The observations forming the basis for this report were made upon dogs by studying the stomach *in situ* through a laparotomy incision after surgical operation at an earlier date. The exposed surfaces were kept moist and warm and the edges of the wound were held open only enough to permit observation of the parts desired. The observations made are not at variance with the findings obtained by other methods.

KLEIN, EUGENE. Gastric motility, II. The conduction of the gastric peristaltic wave. *Arch. Surg.*, February, 1926, xii, 583–590.

While there is no direct proof that a conduction system exists along the lesser curvature, numerous facts nevertheless tend to show that this curvature is more closely connected with the orderly propagation of gastric peristaltic waves than any other part of the stomach. It is well known that any severe lesion of the small curvature is followed by a disturbance in motility which is due in part, at any rate, to weakening of the peristaltic wave.

The lesser curvature is the most irritable portion of the stomach, and irritation there may lead to a circular contraction of the entire segment. These points permit the adoption of the following working hypothesis:

The gastric wave starts at a nodal center on the lesser curvature. As it reaches each point on the lesser curvature the entire circular ring at that level contracts and so the peristaltic wave passes down. At the reentrant angle there is a nodal center for the muscular activity of the antrum. Irritating lesions on the lesser curvature may cause a persistent contraction of the circular muscle at the level of irritation. Excision or destruction of a portion of the lesser curvature disturbs the orderly conduction, and weakened peristalsis results beyond that level; the impulse reaches the muscle distal to the lesion by passing down along the lateral and greater curvature. A segmental or sleeve resection is followed by a complete block in conduction and the establishment of an independent rhythm beyond the level of the suture line.

KLEIN, EUGENE. Gastric motility. III. The mechanism of the pylorus. *Arch. Surg.*, June, 1926, xii, 1224–1254.

Cannon's theory of the acid control of the pylorus has long been accepted by numerous physiologists; but numerous experiments have made it appear that this theory can not explain some of the observations that were made. It was seen time and again that every wave progressing to the pylorus forced gastric chyme into the duodenum. These observations made directly through laparatomy incisions by Klein have confirmed similar ones made previously by other workers.

The acidity on the gastric or duodenal side of the pylorus does not normally control the activity of that sphincter. The factor of prime importance is the fluidity of the chyme in the antrum. Solid bodies which by chance get into the antrum are carried back into the body by retrograde peristalsis.

Each advancing peristaltic wave overcomes the tone of the pylorus and forces some of the chyme into the duodenum regardless of whether the reaction of the chyme is neutral, acid or alkaline. The period of chyme ejection during which the pylorus is open occupies a greater part of the gastric cycle than the period in which it is closed. In other words, the pylorus is open for a longer time than it is closed.

The pyloric tone normally keeps the sphincter closed when the pressure on either side is insufficient to overcome it. This represents one type of pyloric closure. It is overcome, on the one hand, by each advancing gastric wave and, on the other, may be overcome by retrograde peristalsis in the duodenum resulting in intestinal regurgitation. Firm, decisive closure of the pylorus occurs at the termination of each peristaltic wave when the latter has reached the sphincter and after it has forced the chyme into the duodenum. It effectually prevents any regurgitation. The latter closure always occupies the same proportion of time in the gastric cycle. Roentgenoscopic observation of the pylorus should differentiate between these two types of closure.

KLEIN, J., AND KLÖVEKORN, G. H. A new device for insuring presence of filter in roentgen therapy. *München. med. Wchnschr*, Oct. 16, 1925, lxxii, 1782.

The devices suggested by Baastrup and Fischer and by Kriser employ a double hook making it practically impossible to forget the inclusion of the filter, but these devices cause a certain loss in voltage. The ideal device is one which makes it absolutely impossible for operating the roentgen apparatus in the absence of a filter. Such a device is described, and consists of a magnetic control which in the presence of a filter permits the operation of the rectifier arms of the induction machine; if the filter is absent the circuit is broken and the rectifier is locked so as to prevent operation of the roentgen tube.

KÖHLER, ALBAN, The technique of roentgenographing with a Bucky diaphragm. *München. med. Wchnschr.*, May 22, 1925, lxxii, 858-860.

The main field of utility for the Bucky diaphragm is in the examination of the following: kidneys, ureter, bladder, liver and gallbladder, dorsal and lateral inspection of the spinal column, pelvic examination, hip joints, cranial injuries and perhaps lateral projections of kidneys, duodenum and rectum.

The Bucky diaphragm for use in roentgenoscopy has been known for a matter of ten or

eleven years, but the diaphragm for making roentgenograms has appeared in Germany only during the past year. The latter is hailed as a revolutionary introduction. Since the amount of radiation required for the production of a roentgenogram with the aid of the Bucky diaphragm is two to three times greater than without the diaphgram, it is important that the patient be protected by at least 1 mm, aluminum. It is moreover necessary to use double films with intensifying screens. By the use of aluminum cassettes, which keep the intensifying screens uniformly compressed against the films, it is possible to obtain excellent roentgenograms. If it is found necessary to secure additional roentgenograms, one should wait two or three days or longer in order to avoid the possiblity of a roentgen injury to the patient. This is especially true for examination of the head if epilation is to be avoided.

KONDRATJEW, N. S. The problem of cell respiration. I. The effect of radium rays on the oxidation mechanism in the cell. *Strablentberapie*, 1925, XX, 771–792.

Some aspects of cell oxidative phenomena were studied by observations of epidermal and stomatal cells in the leaf of the white lily. Staining methods were used for distinguishing between ferrous and ferric iron and their distribution within the cell. The seat of the oxidation reduction processes appears to be in the chormatin substance of the nucleus and the essential rôle of iron consists in a change in valence. The change from the ferrous to the ferric condition is a natural and continuous reaction which is dependent upon the functional intensity of the cell. Considering the preparation "en masse" there is present a multiplicity of oxidative stages of the iron especially within the nuclei, while the nucleoli appear always to contain their iron in the ferrous (reduced) condition.

Exposure of the plant leaf to beta and gamma rays from radium results in a primary response in the reduction processes of the cell neclei. A secondary response consists in the ability of the cell to return to normal and hypernormal oxidation-reduction functions. These responses occur within certain ranges of dose which, if overstepped, causes merely a destruction of nucleus and cell. The usual pathological changes in form and structure of the nucleus and of the cell usually go hand in hand with the alteration in the oxidation-reduction system of the nucleus. The staining reaction before irradiation shows a polychromatic response to the stains, while after irradiation the nucleus shows a monochromatic reaction.

LIEBER, G. D. Physico-chemical action of roentgen rays in the organism. III. *Strablentberapie*, 1925, XX, 93–102.

Various animals were irradiated over a relatively small skin area with an epilation dose, and histologic study was then made of the irradiated skin to see if the potassium content of the hair follicles suffered any change. The animals used were white rats, a guinea pig and a dog. The radiation was of 0.1 Å. wave length; the superficial dose was 10 to 40 H, and the area exposed 2 sq. cm. The skin sections obtained from the dog were useless because the skin was so fat that the reagents could scarcely wet them.

Potassium was detected microchemically by the Macallum method. Examination of numerous control tissues showed a distant accumulation of potassium in the hair follicles. There was also a dense narrow zone in the epidermis. After irradiation the potassium in the vicinity of the hair follicle has practically disappeared. The epidermis also shows a different picture: the sharply limited, narrow zone has become very much broadened, irregular and more diffuse.

In a second series of sections, the distribution of calcium was studied microchemically by the Macallum method. In the normal skin the distribution of calcium shows a meshed or netlike structure throughout the skin, with the hair follicles and especially the hair roots practically devoid of calcium. The epidermis also contains practically no calcium. After irradiation the normal orderly distribution of calcium is upset; and the calcium now seems to be aggregated in the direction of the follicles and the epidermis. There is an undoubted alteration in the calcium distribution.

When it is recalled that potassium and calcium ions play important antagonistic rôles in cell physiology, it can be readily seen that a disturbance in the physico-chemical equilibrium of these two ions in enough to account for disturbed functioning of the affected tissue.

LING, CHINGSON Y. Studies in biological resistance to malignant tumors. II. The effect of roentgen rays on the antigenic specificity of certain proteins exposed *in vitro*. *J. Cancer Research*, September, 1925, IX, 305–315.

Rabbits were immunized separately with normal and roentgen irradiated suspensions of *B. typhosus*. The immune sera secured were

studied for agglutination, cross agglutination and agglutinin absorption with the normal and irradiated antigens. It was found that the irradiated antigen was agglutinated by anti-normal serum to the same degree as was the normal *B. typhosus* antigen. The irradiated antigen absorbed the anti-normal agglutinins equally as well as did the normal antigen.

In another series of experiments rabbits were immunized separately with normal and roentgen irradiated horse serum, and the immune sera secured were studied by precipitation, cross precipitation and absorption tests with normal and irradiated antigens. The results showed that the irradiated horse serum was precipitated to the same degree as was the normal one by the anti-normal immune serum. Anti-normal precipitin was absorbed by irradiated antigen equally as well as by the plain antigen.

In a third series of experiments rabbits were immunized separately with normal and roentgen irradiated suspensions of sheep erythrocytes. The immune sera obtained were studied for hemolytic activity, cross hemolytic activity and hemolysin absorption with normal and irradiated antigens. It was found that the irradiated erythrocytes were hemolyzed to the same degree as normal sheep erythrocytes by the anti-normal sheep hemolysin. Anti-normal sheep hemolysin was absorbed to the same exent by irradiated antigen as by normal antigen.

It therefore seems that the proteins in *B. typhosus* horse serum and sheep erythrocytes, when exposed *in vitro* to large doses of unfiltered roentgen rays, do not lose their antigenic specificity as tested by the production of immune sera in rabbits. Agglutinins, precipitins and hemolysins produced by irradiated antigens appear identical with those produced by the non-irradiated antigens in each instance.

LORENZ, EGON, AND RAJEWSKY, BORIS. The problem of intensity distribution of roentgen rays in an irradiated medium. *Strahlentherapie*, 1925, XX, 581–631.

A general discussion is presented of the ionization and photographic methods of determining roentgen-ray distribution. The ionization method is carefully analyzed and it is shown to be affected by six different factors (chamber construction, lag effect, shadow effect of the chamber holder, absorption effect of the holder, directional and diffusion effect, and high intensities), which render the results unreliable, so that, strictly speaking the method is good only for dose registration and for controlling measurements at the surface. For measurements within a medium, the data of the ionization chamber must undergo important corrections that are entirely dependent on the experimental conditions and are in part indeterminate. At best, they can be found only experimentally for each point. For practical radiotherapy the determination of these corrections is too troublesome so that they are neglected, and the chamber is employed without correction for purely orienting determinations of intensity.

The ionization method is consequently useless for measurements of standard intensity within a medium. On the other hand, taking into consideration the advantages and disadvantages of the photographic method, it is shown that the latter is of use for the purpose. Errors may enter the photographic method through the film material, the development technique and the precision of photometry. On the other hand, the method has in its favor the fact that (1) all the measurements are made simultaneously so that errors in the apparatus are eliminated; (2) reproduction of the correct local points of intensity in the irradiated medium; (3) ability to react to all the energy transformations produced by the rays in the medium traversed.

A repetition was made of the series of measurements published by Holfelder under exactly similar conditions, and it was found that Holfelder's measurements were inaccurate because they were affected by the general errors inherent in the small ionization chamber and partly by error in measurements. As a consequence, Holfelder's "standard values" lose their significance. It is shown that Holfelder's general critique of Dessauer's isodose tables is unjustified; and his efforts to correct the previous errors are merely an approximation and do not represent absolute values.

Holfelder's brief summary of the most important consequences for practical radiation therapy needs to be modified as a result of the above findings. This modification is given by the authors as follows: (a) The primary beam is surrounded by a mantle of secondary radiation of low intensity whose form, peripheral intensity and total intensity vary widely according to the conditions of irradiation, and which consequently should always be considered in practice; (b) the screen at the surface of the water phantom and the screen near the roentgen tube produce each a different shape of the secondary ray mantle. The first gives a converging (approximately pear-shaped) form, while the latter gives a more intense and diverging secondary

mantle. The peripheral intensities may therefore reach considerable values, especially in the first few centimeters of depth, so that the sharp delimitation of the primary beam may be considerably wiped out; (c) with the screen close to the tube there is a relatively lower requirement of the superficial layer of the irradiated medium and correspondingly greater percentage depth effect in practice. Therefore it is recommended that there be a strict differentiation between the two forms of screening, and wherever careful protection of the superficial layers and greater depth effect is desired the screen should be used near the tube; (d) the intensity distribution in the central ray depends on many factors such as quality and homogeneity of the radiation, location of the screen, etc. The very gradual fall in intensity in the first few centimeters of the irradiated medium which is shown by the test objects placed at various depths is influenced not inconsiderably by the disturbing effect of the latter, so that the drop in intensity in this zone cannot be established at present by these measurements. The percentage depth dose is not an independently sufficient index of the depth effect of a beam of radiation, because it does not give sufficient information regarding the path of the intensity curve in the upper levels. The facts that the surface layer (about 1 cm.) receives relatively high intensities, and the intensity decrease further down becomes flatter furnish the theoretical reason for used layers of covering mats as an aid to homogeneous irradiation of extensive areas.

Lundqvist, Arvid. A graphic device for determining the depth dose (especially for use with Voltz's dosage tables). *Acta radiol.*, 1925, iv, 378–385.

The dosage tables published by Voltz in 1921 represent the most complete and systematic data, and the present author, without assuming responsibility for the correctness of these tables, describes a graphic device facilitating the use of the above tables.

On a circular disc there are drawn curves with radial ordinates for different skin focus distances, in which each ordinate corresponds to an increase of 1 cm. in the depth distance below the surface. Only the highest and lowest values are shown: the situation of the other curves which express the alteration in the dose in different "percentages of depth dose" and different size of field, are obtained by graphic interpolations with the help of a triangular plate having lines converging to the angles. For fields of 150 to 400 sq. cm. the dose is established by means of multiplication of certain factors, a process which is performed graphically, while the curves are shown in the logarithm of the dose concerned. The result is read off direct in percentage on a scale.

The principle of this graphic device would also seem to be useful in the construction of newer systematic measurements.

Lysholm, Erik. Apparatus for precise radiography. *Acta radiol.*, 1925, iv, 507–511.

A description is given of an apparatus which permits very exact adjustment and the use of very small diaphragms. One form of the apparatus is designed for the roentgenological examination of the cranium and enables precise symmetrical adjustments on both sides of the head. Another form of this same apparatus is adapted to the examination of other parts of the body.

The object to be roentgenographed can be fixed by an arrangement regulated within wide limits and by means of which it is possible to fix the object at three points. The roentgen tube is mounted on a curved frame so arched that the angle of the central beam can be controlled.

Lysholm, Erik. An improvement of the Forssell roentgenoscopic screen. *Acta radiol.*, 1925, iv, 608–610.

The author describes a useful alteration of Forssell's roentgenoscopic stand wherein the roentgen-ray tube suspended in a gimbal-like manner can be freely moved in a horizontal as well as in a vertical direction. The arrangement has proved itself particularly useful in the examination of interlobar thoracic conditions of the anterior as well as the posterior mediastinum.

Malmström, V. Investigations concerning the influence of light on fat and kindred substances, therapeutical experiments with a preparation produced from irradiated cod-liver-oil. *Acta radiol.*, 1925, iv, 173–200.

A large number of substances were examined to determine their ability to blacken a photographic plate after ultraviolet irradiation, or of an increased capability of blackening the plate where the property already exists in the unirradiated substance. A positive result was obtained after ultraviolet irradiation in the air of the following substances: Codliver oil, cholesterol, lecithin, human subcutaneous fat, ox and hog fat, butter, certain margarines, cocoa butter, hardened peanut oil, linseed, olive, colza, almond, castor and chaulmoogra oils, ol. lauri, ol. hyoscyami inf., sapo albus and also

human skin secretion absorbed in a gauze worn next to the body for several days. Positive reactions were also obtained with camphor, amyl alcohol and alcohol extract of malt. Crude turpentine and ether blacken the plate strongly even without irradiation. The various substance after irradiation give off gas or gases having an acid reaction which have the property of acting strongly on the photographic plate.

It may be of interest to record some of the substances that gave negative results. These were glass, water, milk, cream, glycerine, paraffin oil, soft soap, pleuritic exudate, pus serum from empyema, contents of a blister, urine, extract of tuberculous caseous matter, beef bile, gelatin, animal charcoal, casein, egg yolk, egg white, sugar solution, gum arabic solution, starch, commercial malt extract, ethyl alcohol, chloroform, ligroin, quinine solution.

An aqueous extract of irradiated fats possesses relatively strong chemical activity.

Therapeutic experiments have been carried out with such water solutions prepared mostly from irradiated codliver oil. Codliver oil water given *per os* yielded no perceptible effect in tuberculosis of the lung and larynx. On the other hand, subcutaneous injection and local applications of water extract of irradiated codliver oil have given rather striking results. The most constant effect is an analgesic effect in cases of tuberculous dysphagia and pleuritic pain. In certain cases the healing tuberculous foci has undoubtedly been accelerated by local treatment. Some favorable general effects have also been noted. Thirteen cases are reported, describing the clinical effects of this form of treatment.

Mottram, J. C. The reaction of the skin to a radium exposure repeated after varying lengths of time. *Brit. J. Radiol.*, 1925, xxx, 387–391.

Experiments on rats have been made to discover how long after exposure to radium sufficient to produce a mild erythema, a second similar exposure on the same area can be given without a summation of effects. The experiments were carried out on rats' tails, the animals being under ether and urethane. The radium applicator was held over the dorsal aspect of the tail so as just not to touch it thus avoiding any pressure on the tail.

The longest time between two exposures was seventy-six days, by which time the hair had begun to grow again. Three rats were used. There was no summation of effects to be observed. The next interval between exposures was fifty-five days when the hair lost as a result of the first exposure had not yet regrown. Two rats were used in this experiment and no summation of effects was observed.

Three rats were subjected to two exposures of thirty-five minutes with an intervening period of thirty-four days. In this case there was slight evidence of summation. In all of the above experiments the reaction of the skin to the second exposure was normal.

In other groups of animals the period between the first and second exposure was 28, 25, 20, 16, 10, and 7 days respectively. In all of these cases there was definite summation of reaction of the skin to the double exposure. In addition, the reaction of the skin to the second exposure was reduced. There was apparently a desensitization of the skin.

It therefore seems from these experiments that it is necessary to wait for more than twenty-eight days before giving a second dose of radium to the skin when the first dose results in erythema and if an increased skin reaction is to be avoided after the second exposure. At present it is not possible to say why an area of skin in the neighborhood of the first exposure but protected with a thick lead block is made less sensitive to radium radiation. It is also impossible to explain why this should occur only when an area receiving a double dose exhibits summation and not when the area reacts normally.

Wigard, A. The penetrating radiations of high altitudes. *Physik. Ztschr.*, 1924, xxv, 445–463.

This is a comprehensive review with 106 references. Methods of measurement, properties, theories of origin, and connection with other problems are discussed. Repeated observations with the utmost precautions appear to prove the existence of radiation with the properties of gamma rays harder than from any known source, the density of radiation increasing with altitude. No theory of its origin or exact character is as yet established.